

The Q2FY15 RTMA and URMA Upgrade Package

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Outline

- Background improvements for CONUS (HRRR/NAM-CONUSNEST)
 - Examples of feedback from the field
- New variable: GSI-based sky cover (obsolete NESDIS product)
- Terrain-aware gross error check and Buddy check/variational QC
- Precip analysis improvements
- Unified code for all domains

**RTMA/URMA has been designated the
Analysis of Record for the National
Blend of Global Models project!**

We are working with the field

- RTMA listserv (aor-rtma@infolist.nws.noaa.gov)
 - Used to solicit feedback/complaints from field, give updates on implementations
- Monthly conference calls
- Briefings to DOH/SOO's from each CONUS region (WR complete)
- EMC and MDL websites used for evaluation

MDL Google Website info

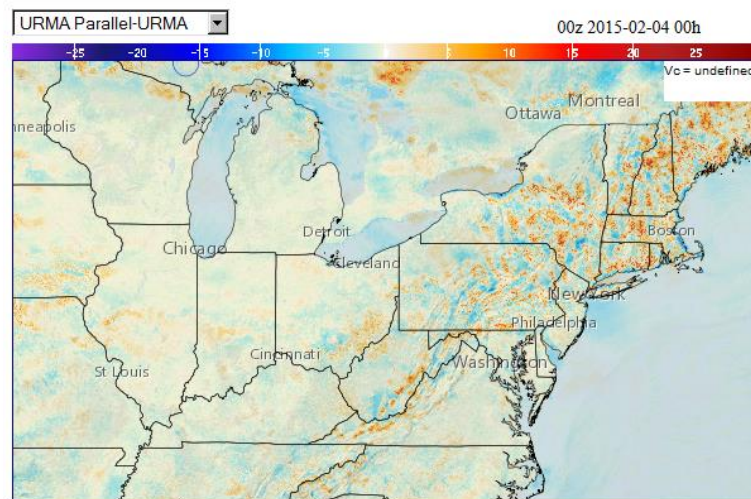
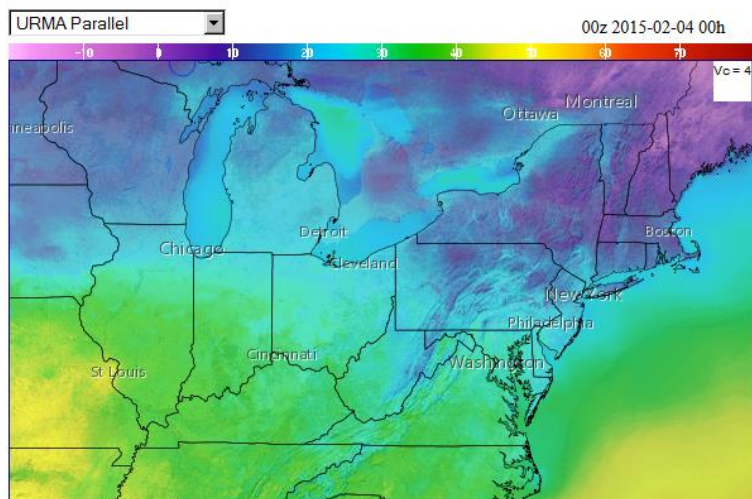
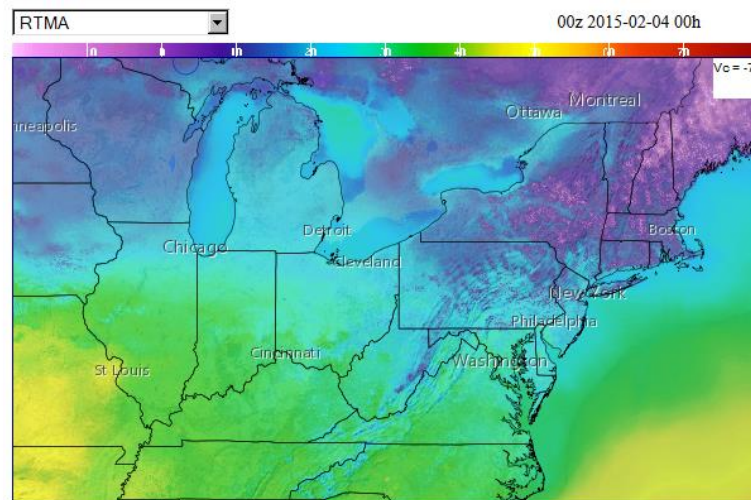
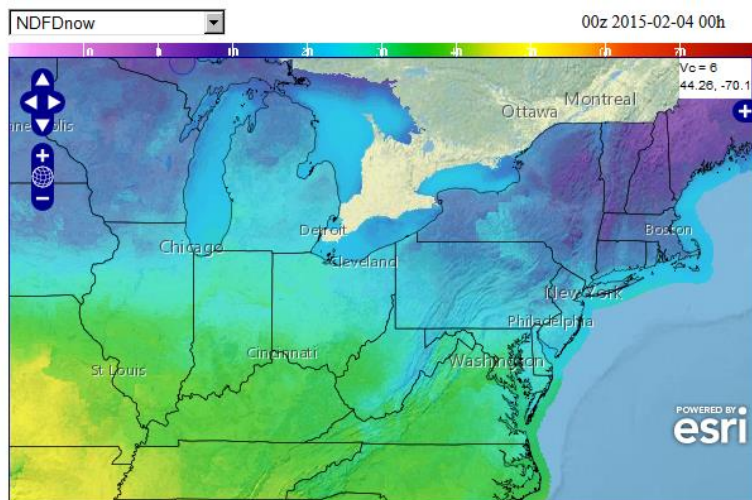
Viewer can be assessed from following link using your NOAA email name and password:

<http://www.mdl.nws.noaa.gov/~blend/blender.prototype.php>

List of most recent enhancements can be found at:

<http://www.mdl.nws.noaa.gov/~blend/NewFeatures.dev.html>

This part-1 upgrade is in direct response to Western Region's request for a HRRR-based first guess and a smarter observation QC to help with the analysis over their complex terrain.



Background Improvements

RTMA/URMA: CONUS: Use 13 km RAP 1 hour forecast, downscaled to 2.5 km using “SmartInit” to create background field. 13 km model does not resolve terrain-induced features (eg valley cold pools). Use of single model makes RTMA susceptible to RAP biases (eg temperatures over snow cover).

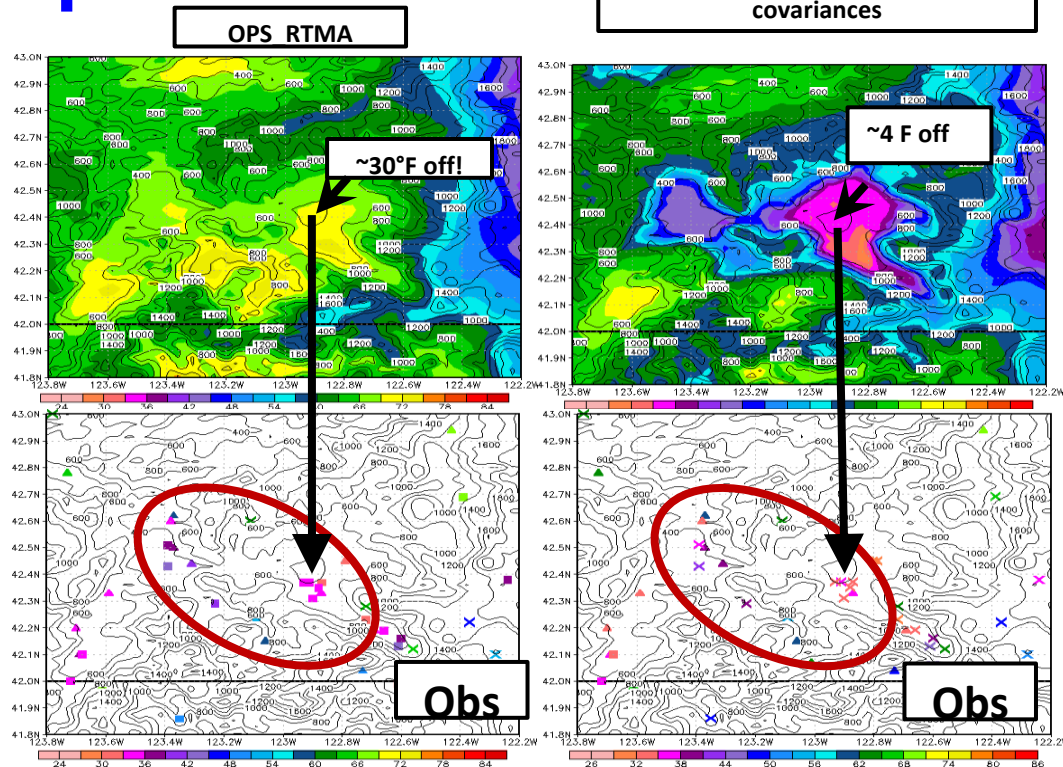
Planned upgrade for Q2FY15: Generate background from blend of HRRR (3 km) and CONUS NAM nest (4 KM). Higher resolution models and land/sea mask will allow for less extreme effects from downscaling and resolve more mesoscale features than RAP. Blending will prevent a bust in one model from affecting RTMA/URMA.

Use of RAP will still be necessary due to RTMA domain size, northward extension
Based on field feedback, HRRR only will be used as background for visibility and winds.
These changes have been strongly encouraged by the field!

Observation Quality Control & Analysis of Valley Coldpools

PARA_RTMA w/ smart, terrain-aware gross error check + sharper terrain-following covariances

- Current RTMA often misses valley cold pools (l.h.s slides)!
 - Associated with the background field being too warm, thus triggering the gross error checking and rejecting good observations
- Improved results with use of smart, terrain-aware gross error check (r.h.s slides).
- But could potentially lead to bad obs getting in the analysis. Solution: Buddy-check & Variational Observation Quality Control (varQC). Work in progress.
 - varQC: Ob weights vary based on current O-A. No ob is completely rejected based on O-B.



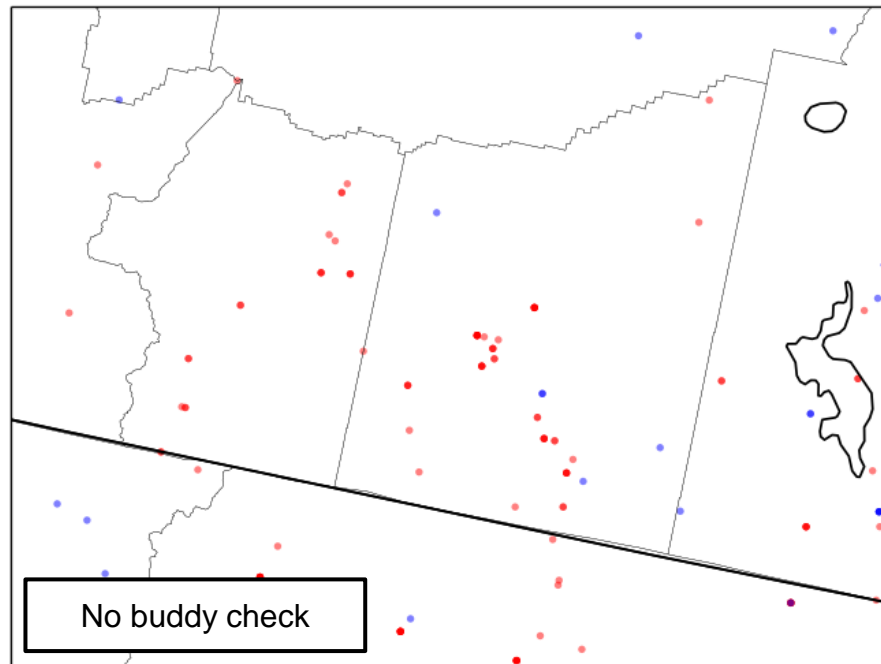
2m-T (F) VALID 22Z 16 JAN 2014 near Medford, OR

cross ==> assimilated ; square ==> rejected by gross error check;

triangles => rejected via blacklist

Buddy Check Development: Example application to Medford, Oregon Case

2 m Temperature Observations **Used** / **Rejected**
in Current Configuration

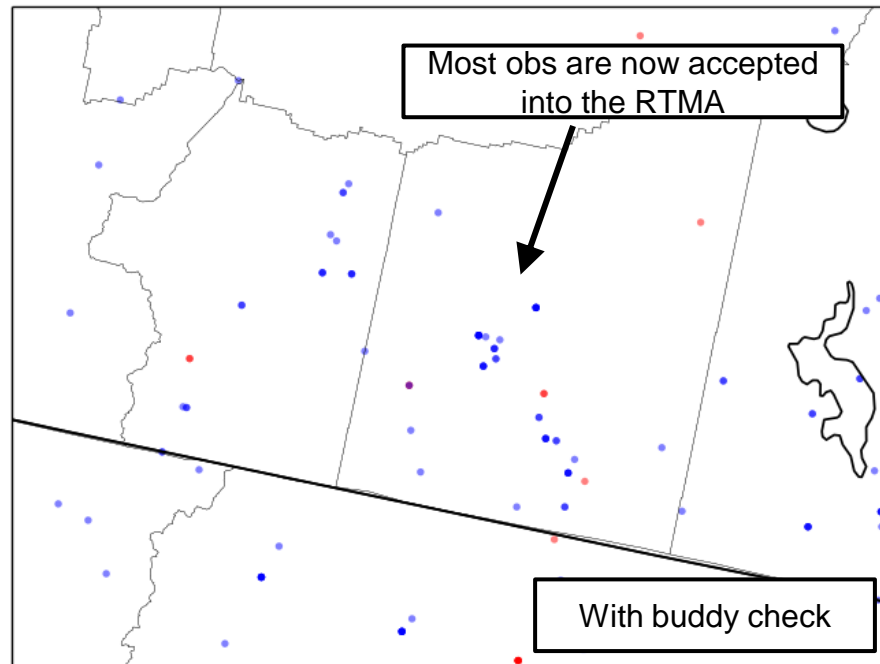


Assimilated

Rejected Assimilated

For this example - reject lists have been disabled

2 m Temperature Observations **Used** / **Rejected**
with Buddy Check



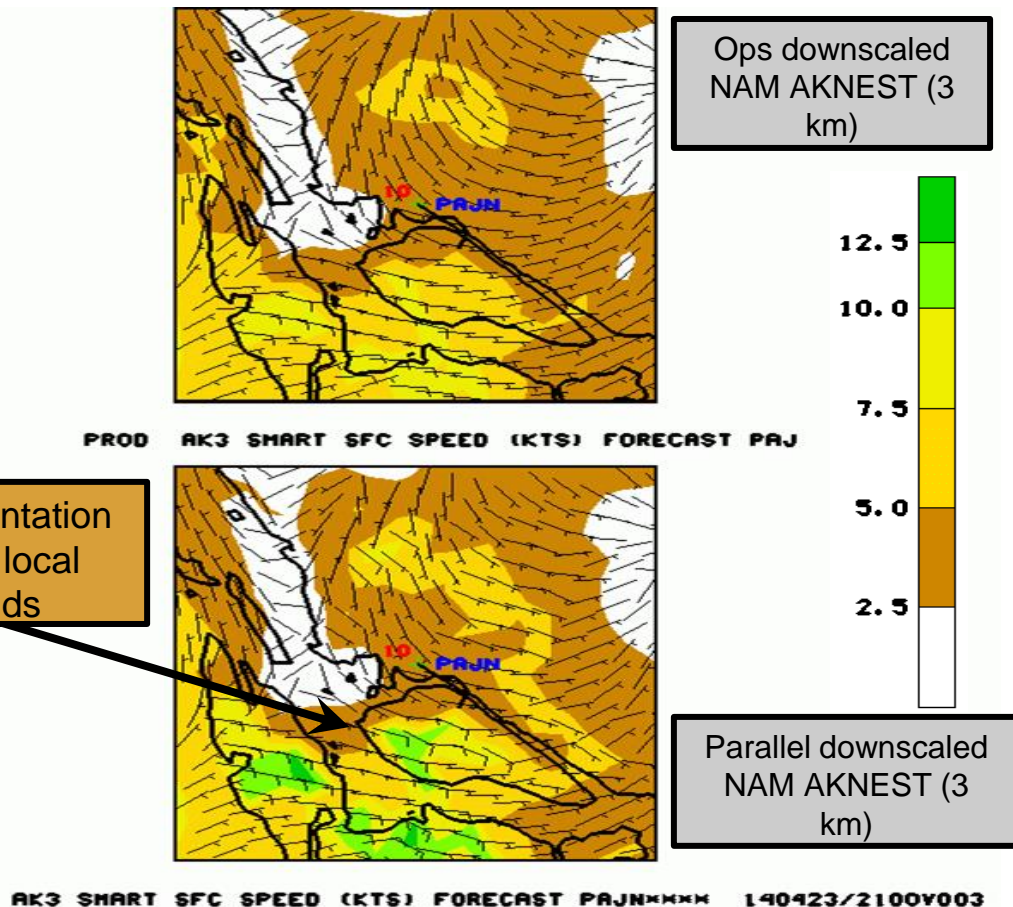
Rejected

We are also pursuing a more sophisticated Variational QC approach.

Improvements For Background Winds

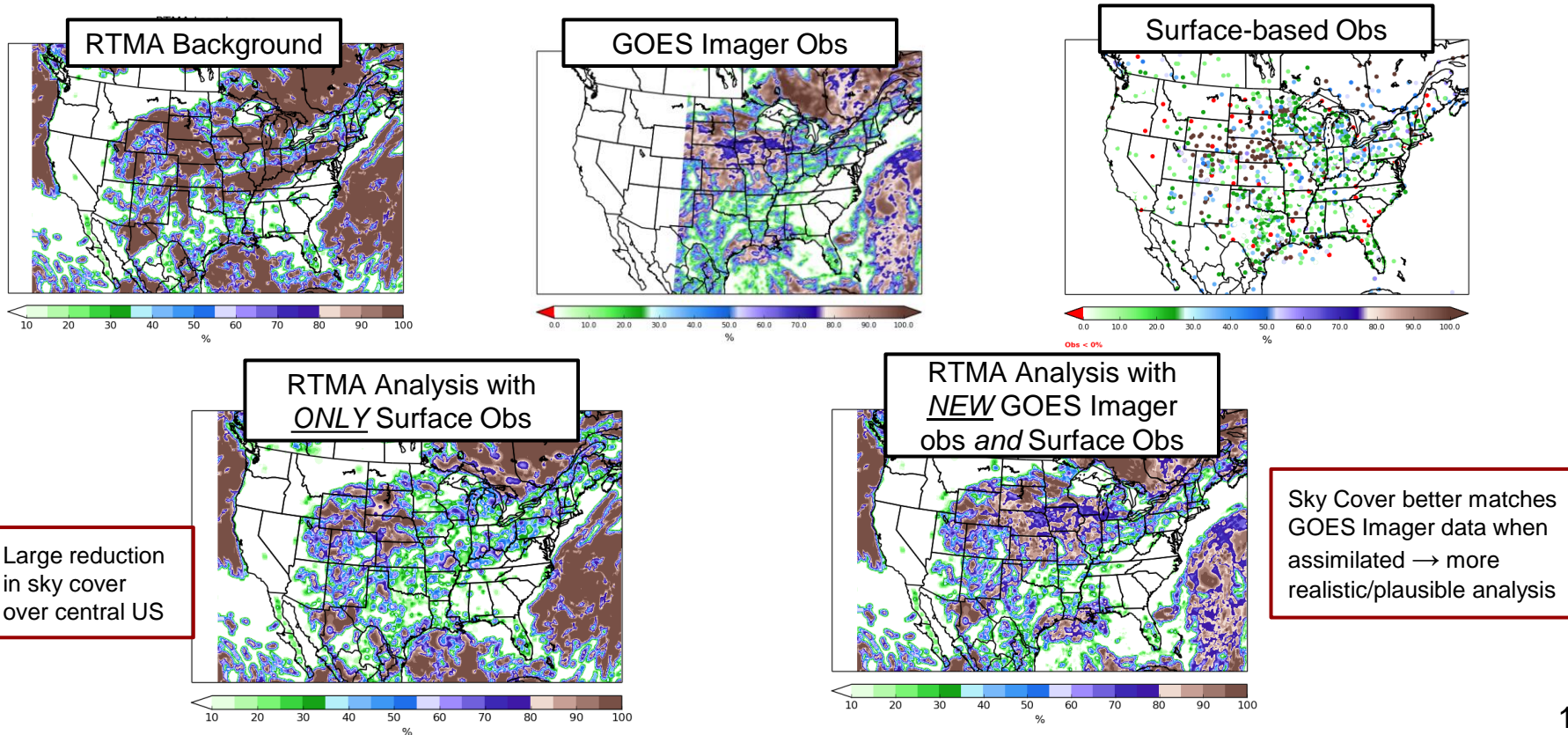
- Currently no real wind downscaling in smartinit. only wind reduction factor
- Particularly problematic for RTMA-Alaska. Poor depiction of along-channel flows.
- To use mass-consistent wind field model to improve downscaling.
 - Based upon velocity potential and incorporates local terrain gradients

Improved representation
of the effects of local
terrain on winds



RTMA/URMA - Sky Cover Analysis Development (NEW)

- Collaboration with J. Gerth of Univ. Wisconsin/CIMSS
 - Establishing NCEP data feed for GOES Imager Sky Cover data produced via GOESR algorithms for use in RTMA/URMA



Precipitation URMA

6-hourly multi-sensor precipitation estimates from the 12 ConUS River Forecast Centers (RFCs) are mosaicked into a national product (the NCEP Stage IV) and remapped to the ConUS and Northwest NDFD grids for URMA.

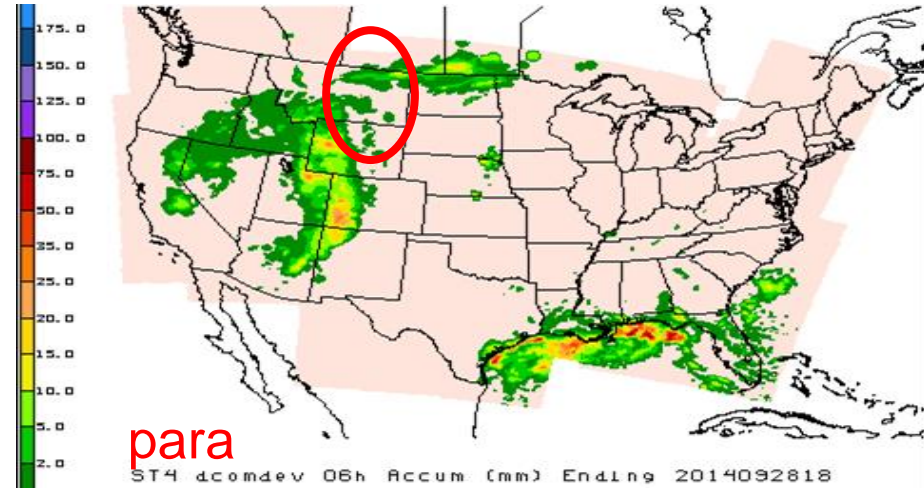
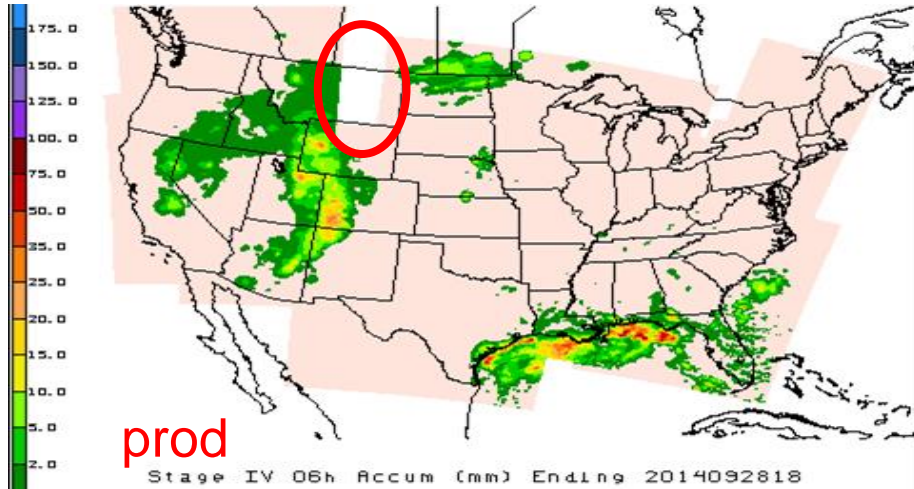
Upcoming URMA upgrade

Nov 2014: NCO implemented a simplified database for incoming QPE data from the RFCs, enabling us to make the Stage IV/URMA upgrade.

In the upcoming RTMA/URMA upgrade package, additional re-mosaics for 6-hourly Stage IV/precip URMA will be made at 1/3/5/7 days after ending of the accumulation time.

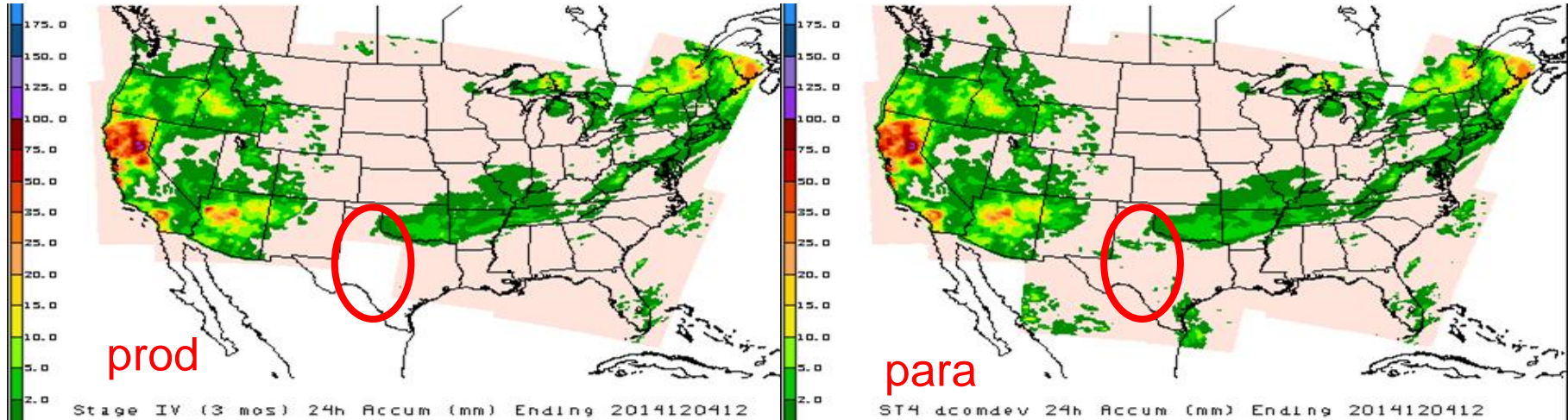
In addition, hourly QPEs from the 8 Eastern/Central RFCs are first summed into 6-hourly totals, then combined with 6-hourly QPEs from the four Western RFCs, to take into account of regional differences in base (primary) analysis.

Example 1: 06h accum ending 18Z 20140928



6-hourly QPE from MBRFC for 18Z 28 Sept was not received until after 15Z 30 Sept, too late to be included in the current production Stage IV/URMA. The 3-day re-run in the new Stage IV/URMA algorithm captured the late update from MBRFC.

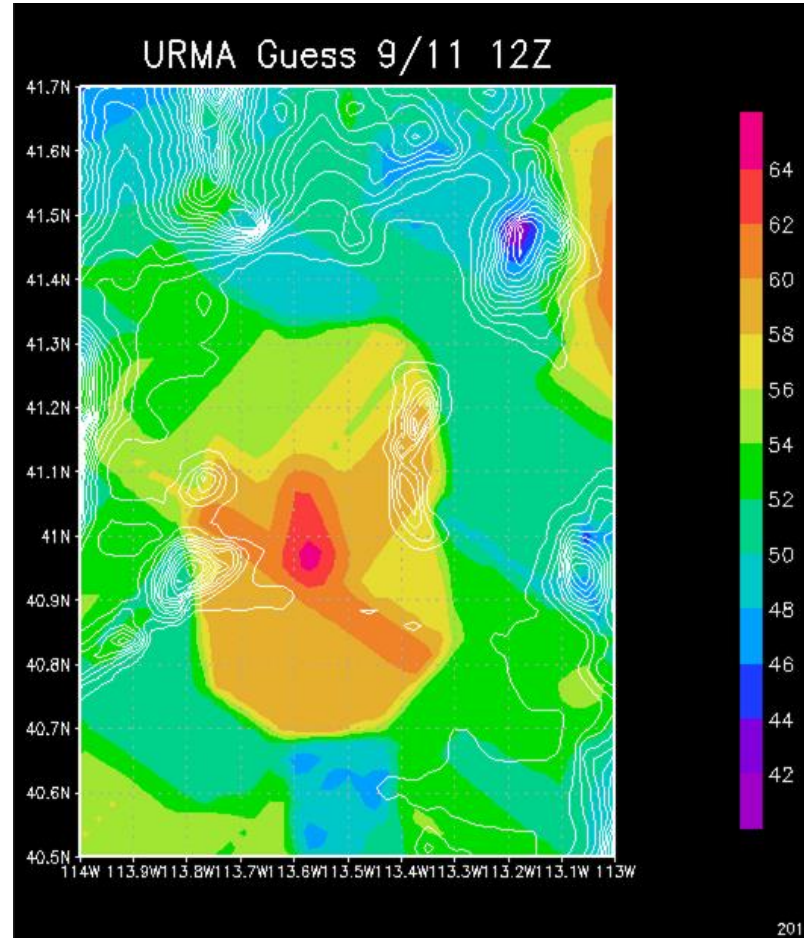
Example 2: 24h ending 12Z 20141204



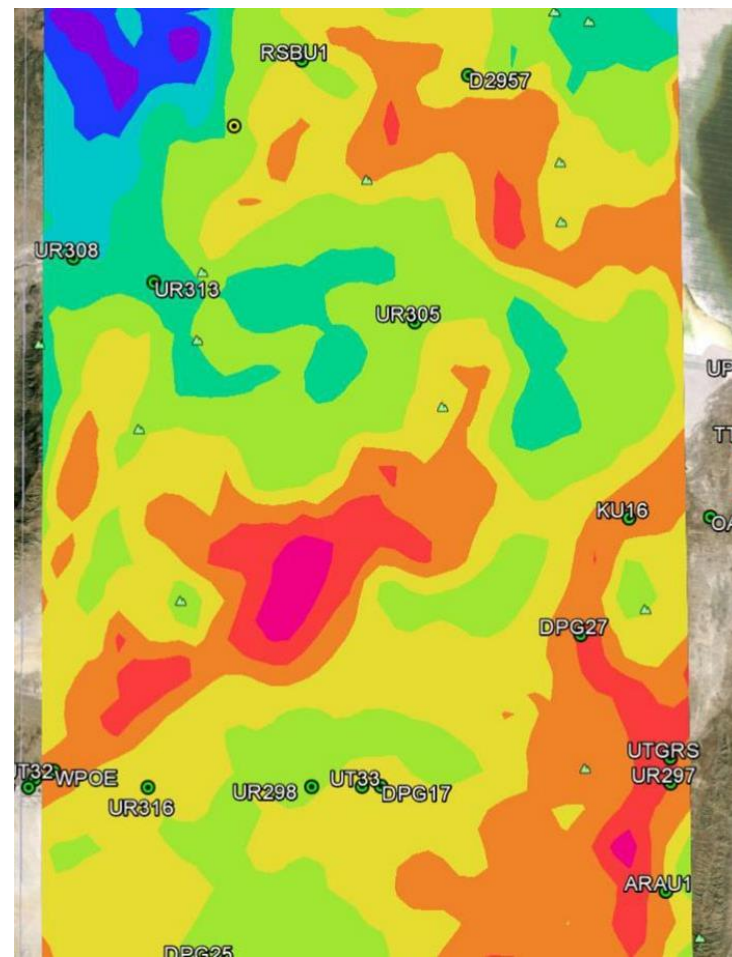
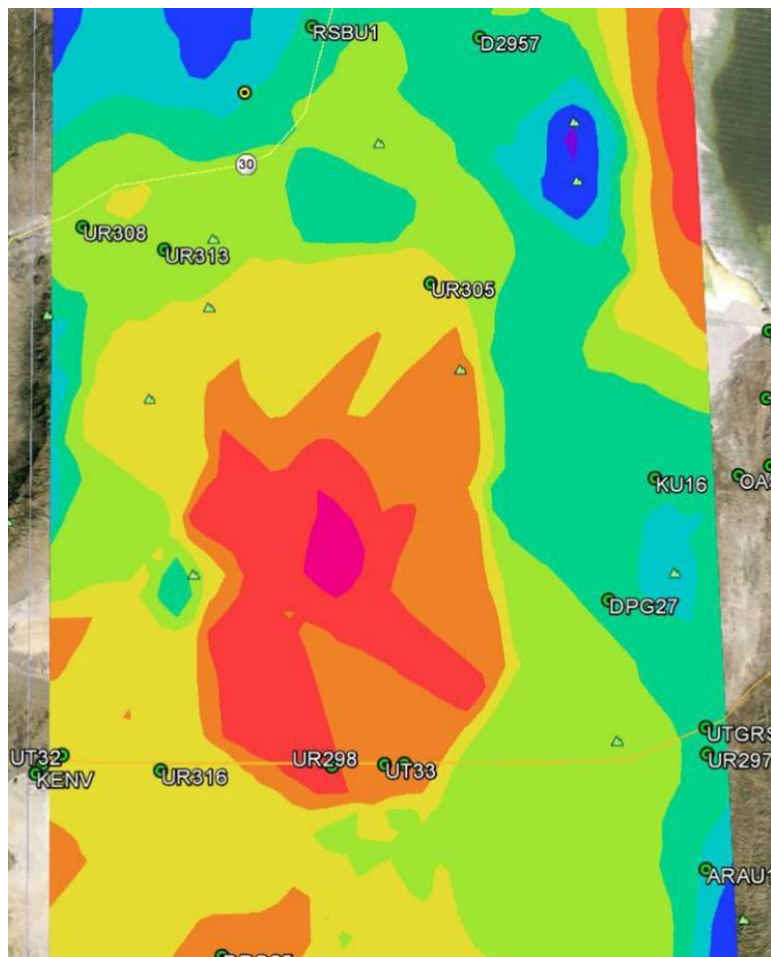
No 6-hourly QPE for WGRFC received for the 24h period ending at 12Z 4 Dec 2014. In the new Stage IV mosaic algorithm, WGRFC was among the Eastern/Central RFCs for whom hourly QPEs were considered base analysis and summed to 6-hourly totals before combining with the 6-hourly QPEs from the four Western RFCs to form the 6-hourly ConUS mosaic, so the outage did not affect the new Stage IV/URMA.

Salt Lake Flats Background Issue

- Warm spot over flats
- Temperature contours do not follow terrain
- “X” shape
- No ob over the bullseye or across gradient
- Invest requested by WR SSD

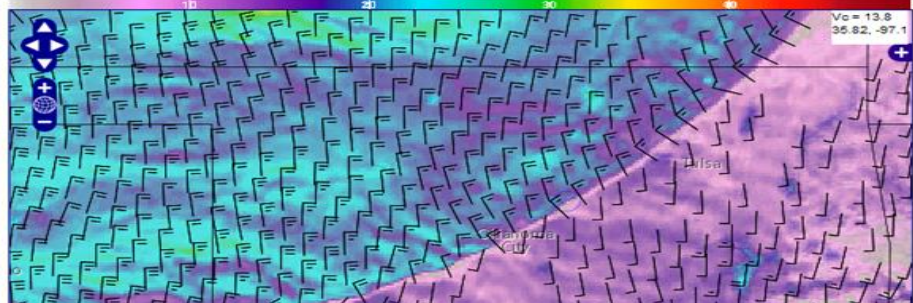


OLD ANALYSIS from 10/2/14 12Z NEW ANALYSIS

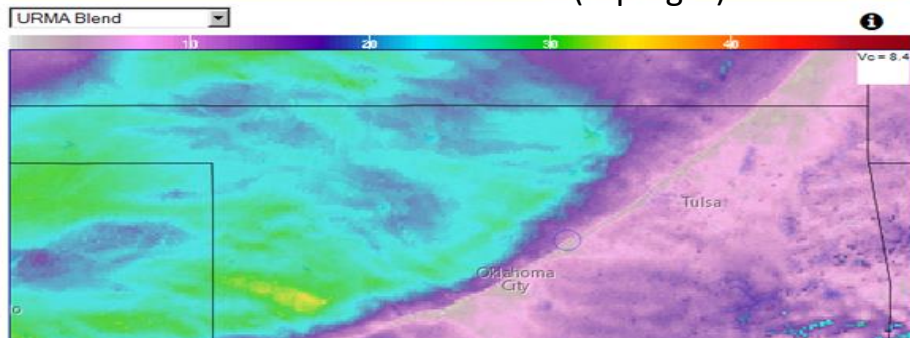
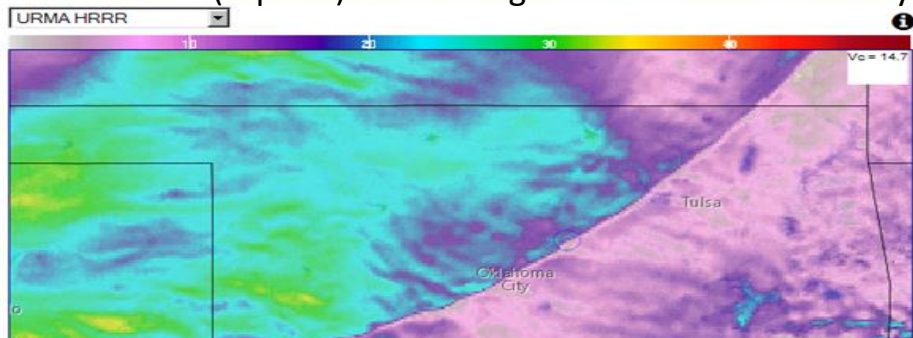
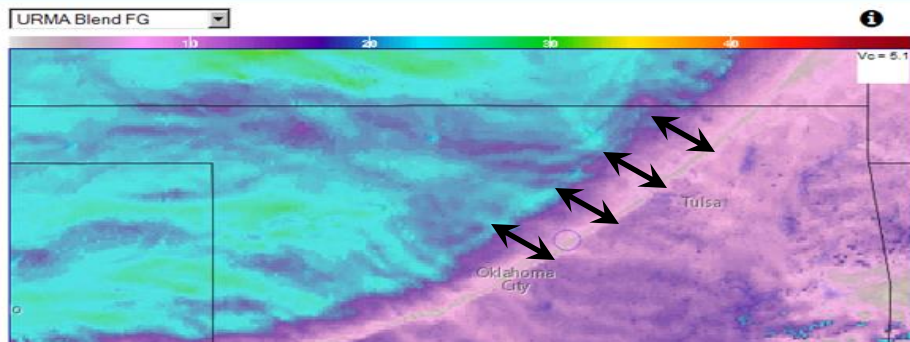


2014-11-11 0200 UTC

URMA HRRR FG Wind Barbs are URMA HRRR



There is a gap between the leading edge of the arctic front and the stronger winds in the URMA Blend FG (top left). The stronger winds are immediately behind the front in the URMA HRRR FG (top right).



In the analyses, the strong winds begin behind the front in the URMA HRRR (lower left). In the URMA Blend, there is a gradual ramp up in wind speed behind the front (lower right).

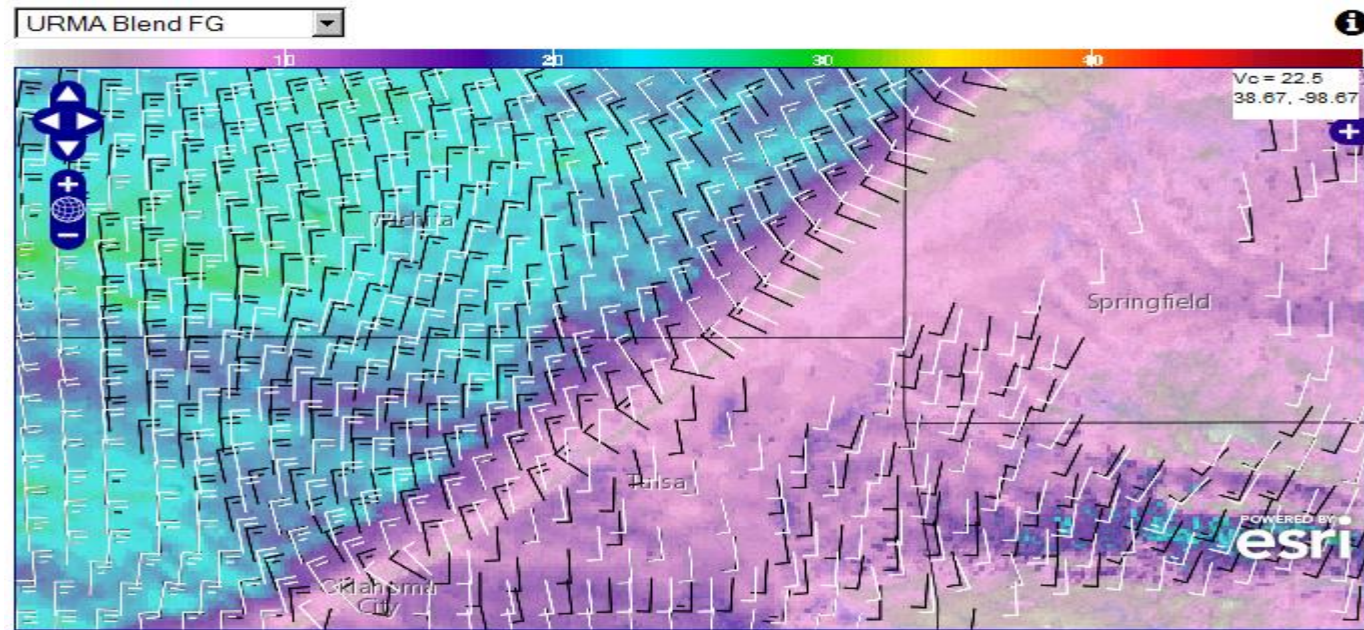
Wind Barbs:

URMA Blend (white)

URMA HRRR (black)

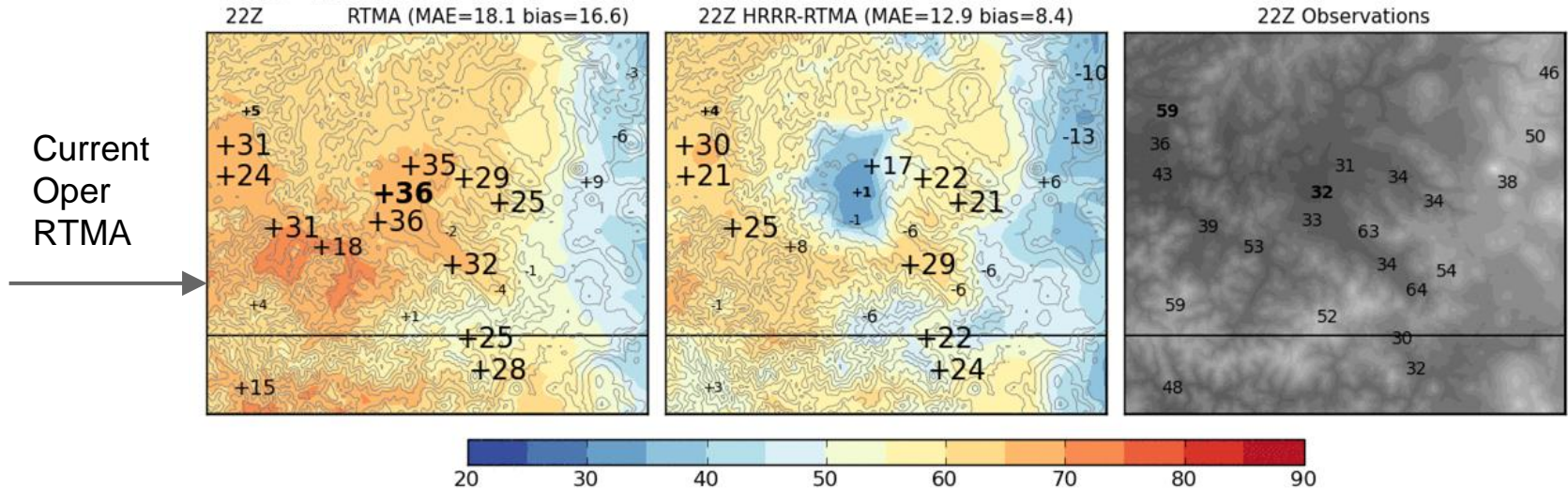
Barbs are plotted for
winds ≥ 10 kts

A quick glance
suggests the barbs are
similar from both
parallels, however
there are some 10-20
degree differences
along the front.



Medford, OR Analysis Problems

Analyses valid 22:00 UTC 01-16-2014
Temperature (F)



- Case presented by Trevor Alcott (WR SSD) at time of last upgrade (Q1FY14)
- Large O-A differences (text values on map) over Medford, OR area
- Issue was not solved by previous upgrade

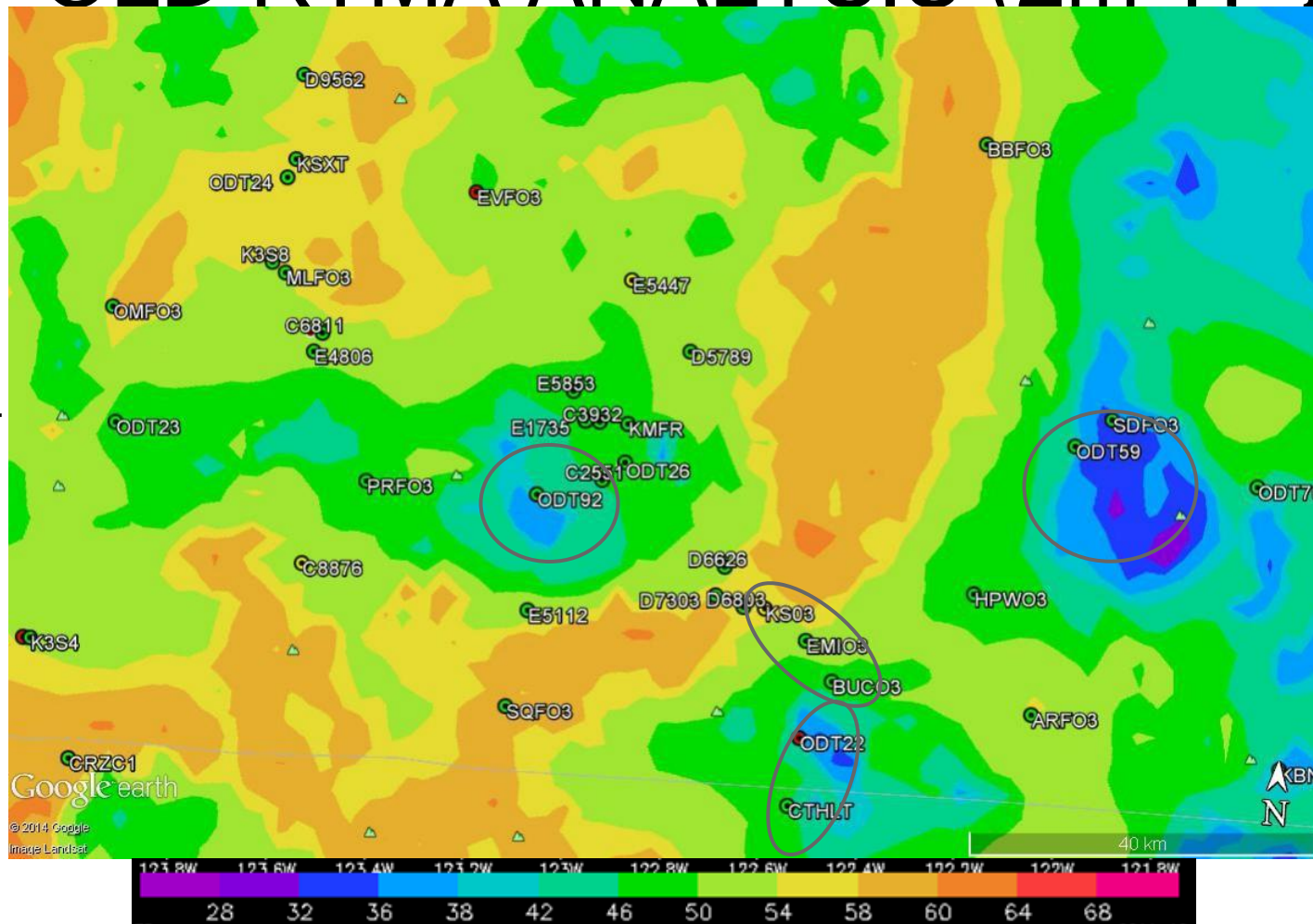
What went wrong

- RAP background mixed out inversion too early in the morning
- 13 km resolution RAP did not properly resolve complex terrain features
- Many mesonet obs in the area were on a WFO/region provided reject list
- Obs not on reject list generally failed gross error check due to large (>30 F+) O-B innovation

What we've done about it

- Relaxed gross error check over complex terrain, buddy check to “save” obs previously thrown out
- Removal of obsolete WFO-provided reject lists (ops and parallel)
- Background now blend of HRRR (3 km) and CONUS NAM nest (4 km)

OLD RTMA ANALYSIS (2m T. °F)



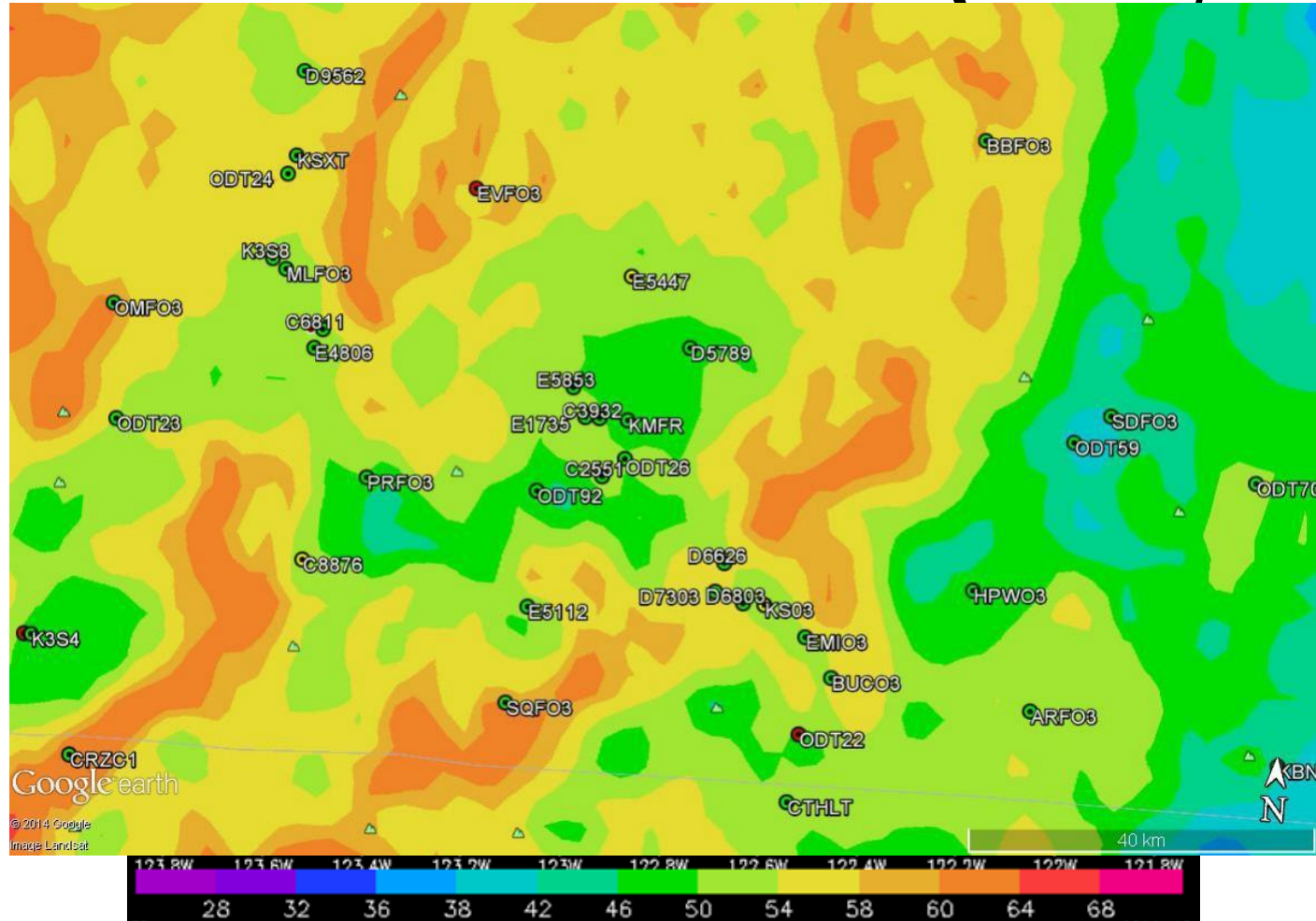
Ob Key:

Accepted

Rejected

Partial
(Crossval)

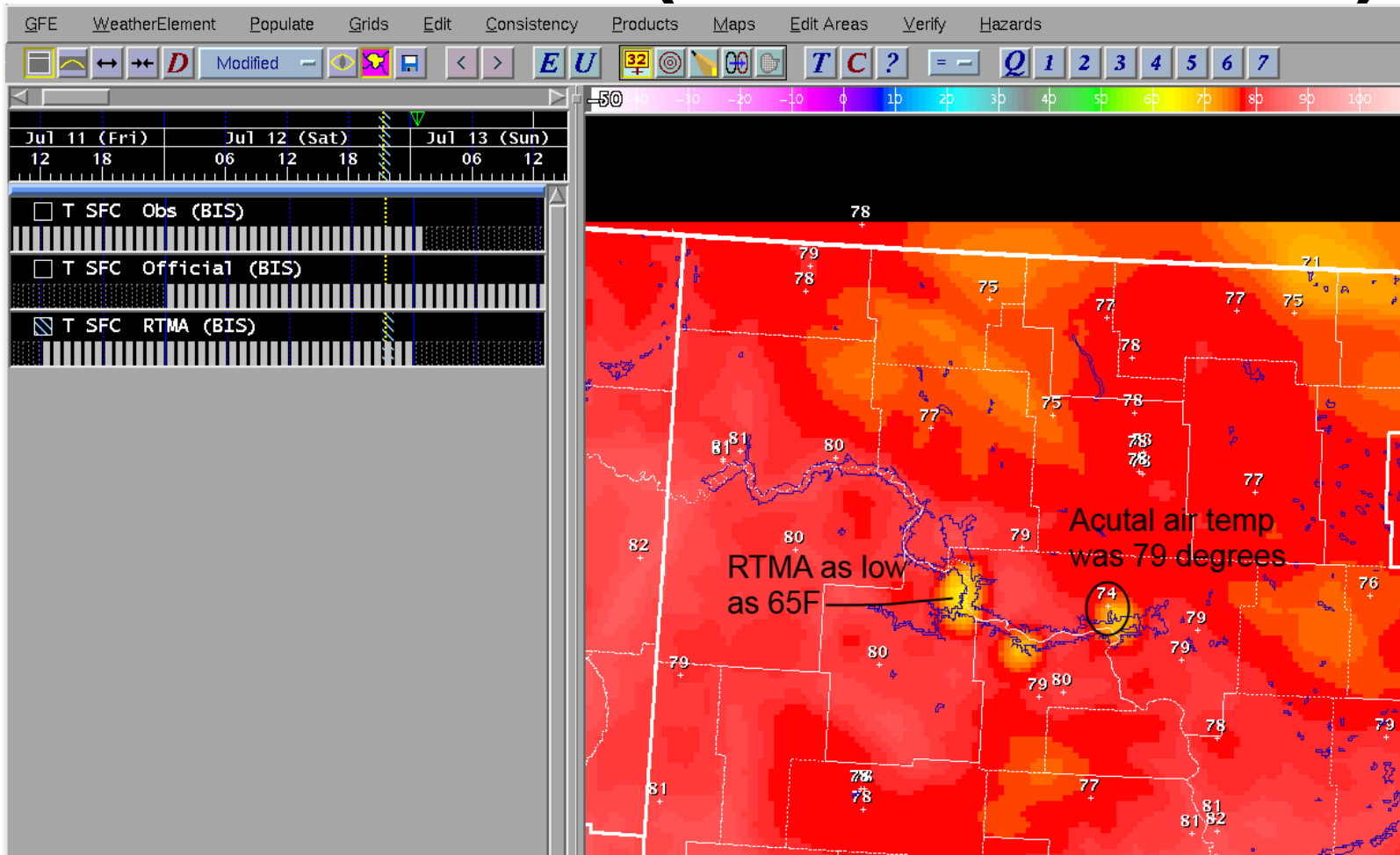
NEW RTMA ANALYSIS (2m T, °F)



Differences at key obs (2m T, °F)

Site	Ob Val	Old BG	Old Anl	New BG	New Anl
KS03	46.31	57.83	55.13	57.83	50.99
ODT92	44.69	44.69	41.45	54.77	47.75
BUCO3	56.93	48.83	48.29	55.13	54.95
EMIO3	55.49	53.87	52.61	55.67	53.69
ODT59	37.85	43.25	41.81	44.15	39.65
CTHLT	50.81	45.59	47.03	54.05	51.71
ODT26	51.53	48.11	48.11	54.23	50.45

Lake Sakakawea (inland lake issue)



File Edit View History Bookmarks Tools Help

RTMA webinar for Central Re... Analysis and Verification - Go... Blender Verif prototype Index of /mmb/rtma2/bproj/hrrr_b... +

www.mdl.nws.noaa.gov/~blend/blender.prototype.php?WFO=BIS

Most Visited Getting Started Latest Headlines NOAA Gmail SRG homepage Perl DBI man page HTML color chart A Short Guide to DBI ... MySQL Cheat Sheet Nextbus - Metro Shut... NCO Support Center ADP Portal

User Documentation

Daily
Monthly

BIS

Element
Temperature

Year-Month-Day
14-10-21-Tuesday

Analysis Hour (UTC)

00	01	02	03	04	05
06	07	08	09	10	11
12	13	14	15	16	17
18	19	20	21	22	23

Forecast (-t)

06	12	18	24
30	36	42	48
54	60	66	72
78	84	90	96
102	108	114	120
126	132	138	144
150	156	162	168

Opacity: 65%

Annotation
Navigate

NDFDnow

Minot

Vc = 74
47.89, -102.35

URMA

Minot

Vc = 71.5

URMA Blend

Minot

Vc = 64

URMA HRRR

Minot

Vc = 69

esri

Start

2:19 PM
10/30/2014

[Forecast View](#)
[Daily Forecast Review](#)
[Daily Analysis Review](#)
[Monthly Forecast Review](#)
[Monthly Analysis Review](#)

bis

Element

Dewpoint

Year-Month-Day

14-10-21-Tuesday



Analysis Hour (UTC)

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<input type="radio"/> 06	<input type="radio"/> 07	<input type="radio"/> 08	<input type="radio"/> 09	<input type="radio"/> 10	<input type="radio"/> 11
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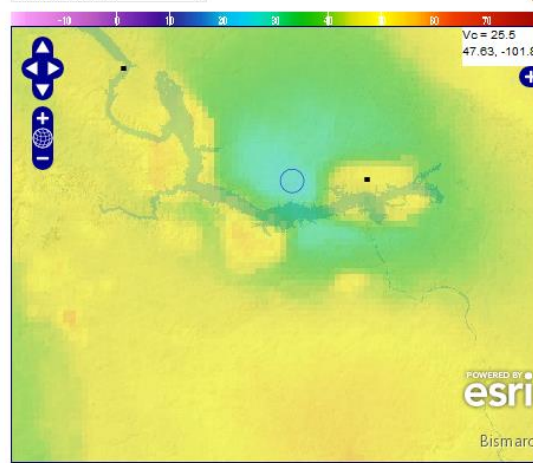
Opacity: 48%

Annotation

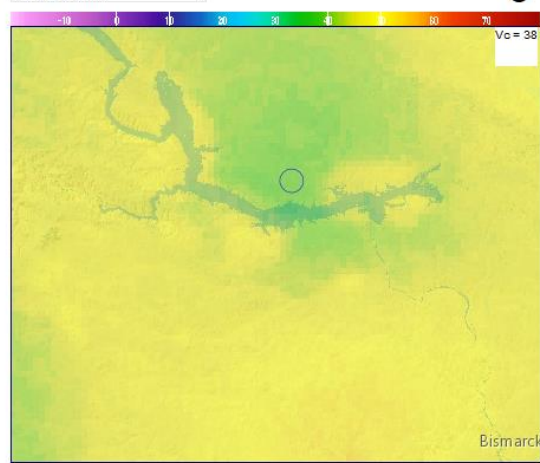
Navigate

[User Documentation](#)

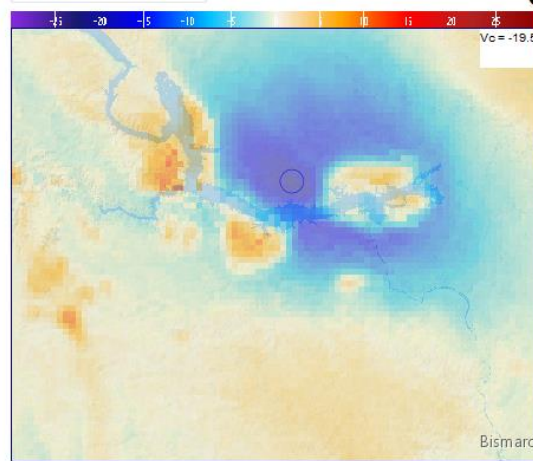
URMA HRRR



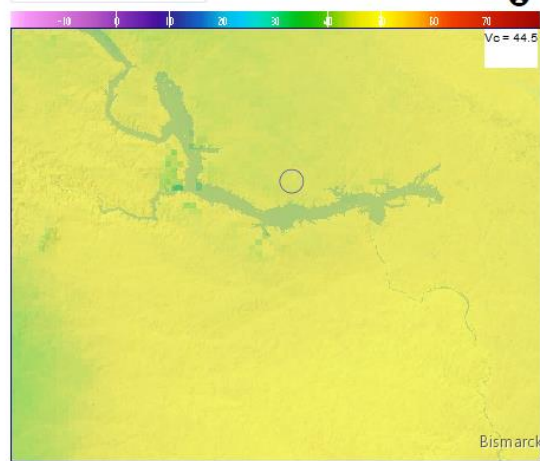
URMA Blend



URMA HRRR-URMA

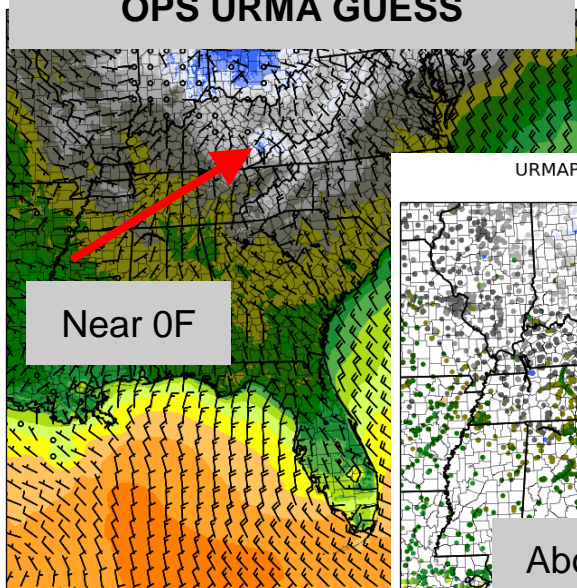


URMA



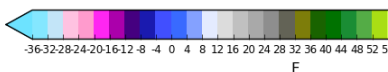
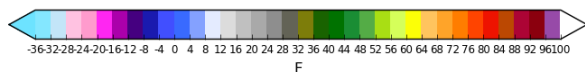
Snow Depth (1 to 4 inches in circle)

OPS URMA GUESS

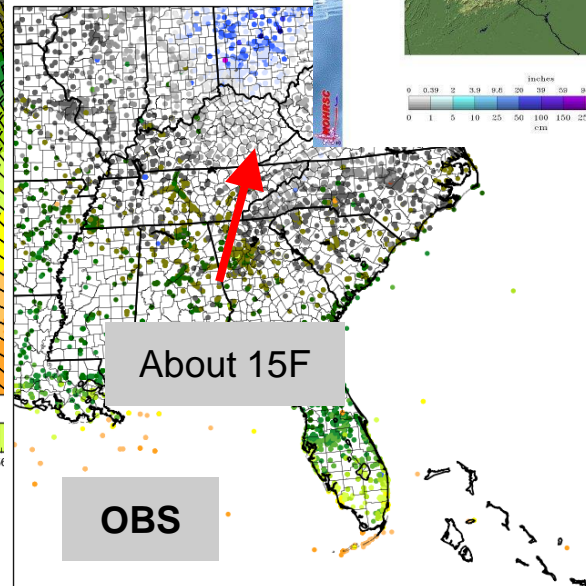


Near 0F

About 10-15F

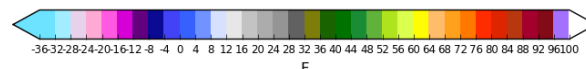
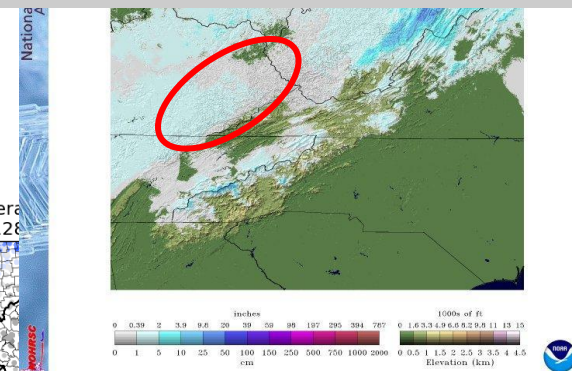


URMAP 2 m Temperatura
20150128

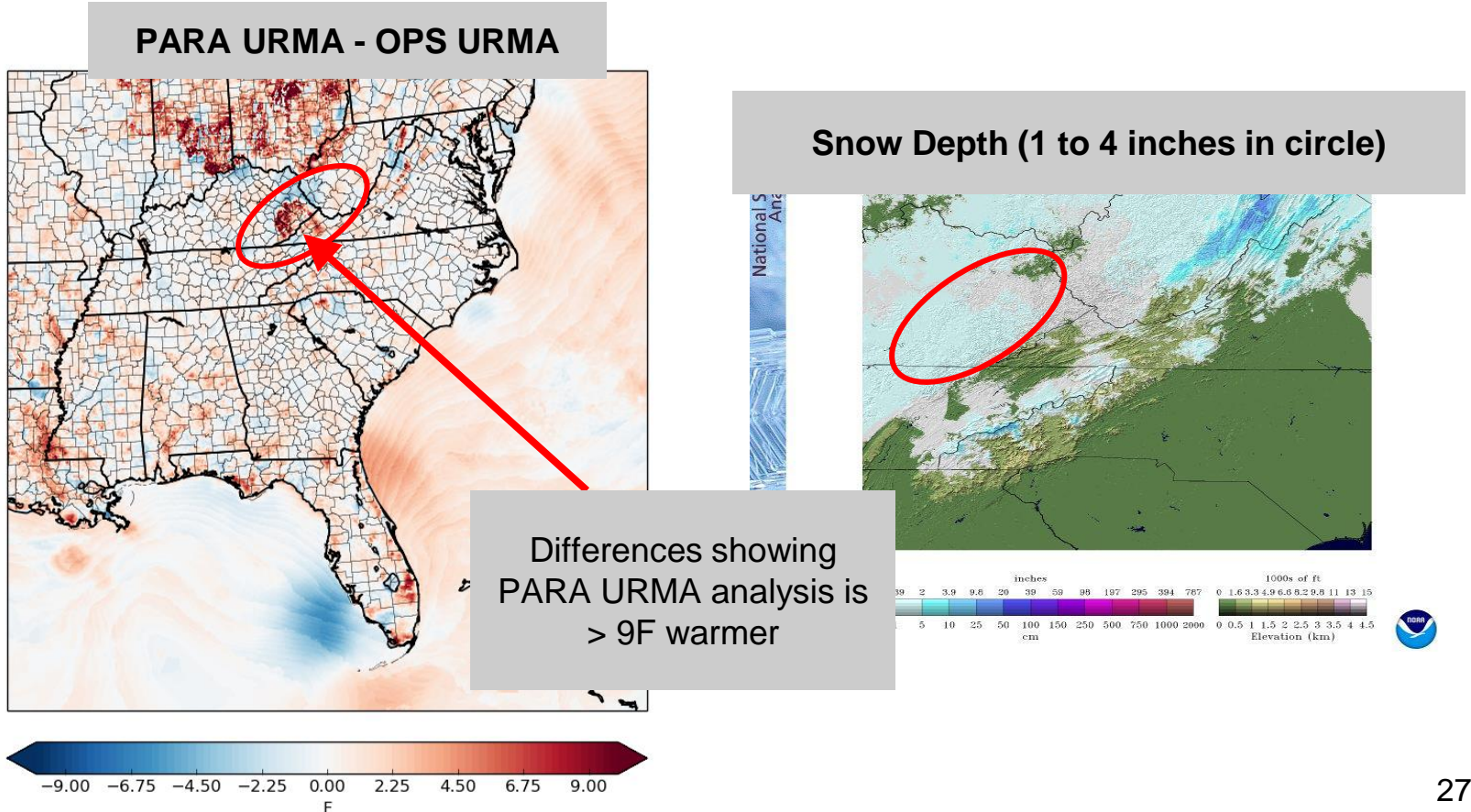


About 15F

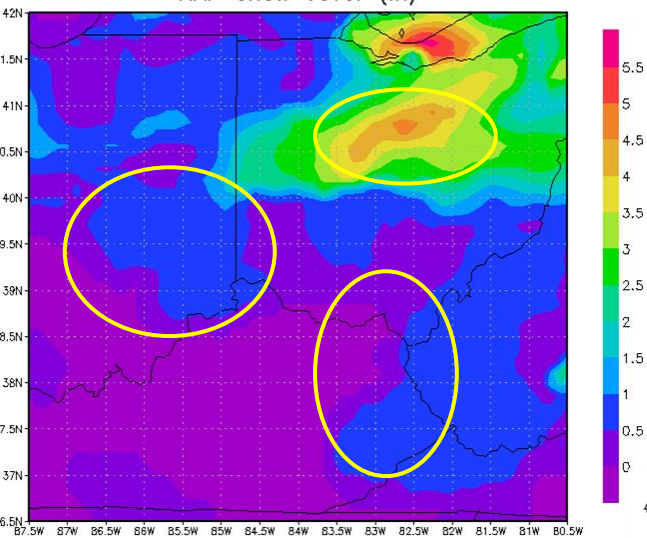
OBS



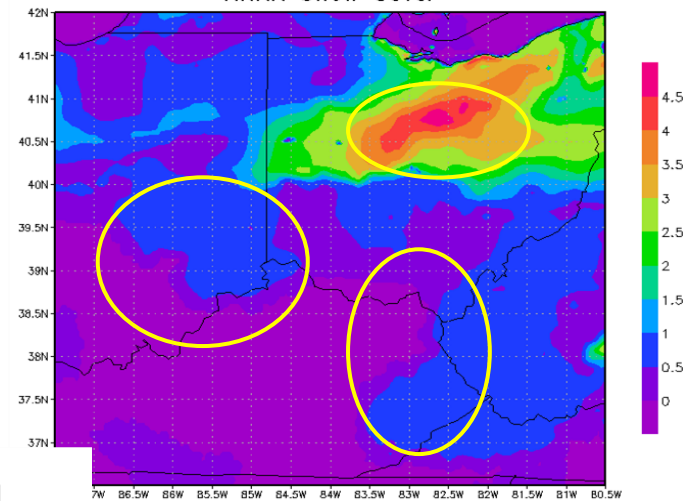
Better background, less problems over snow = Better Analysis



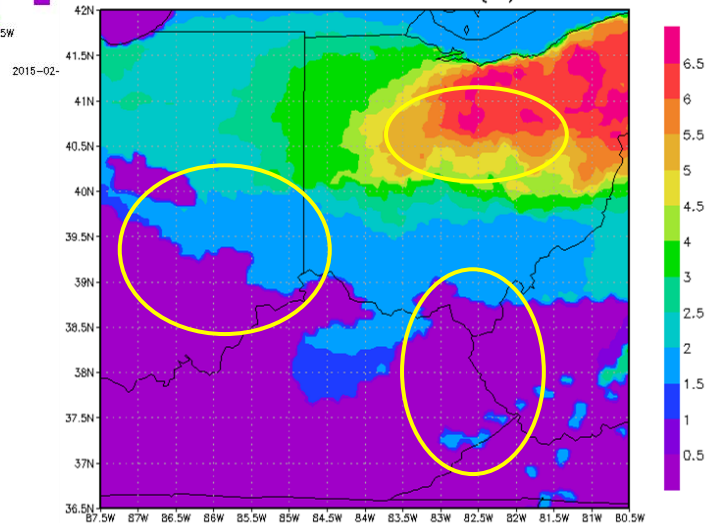
RAP snow cover (in)



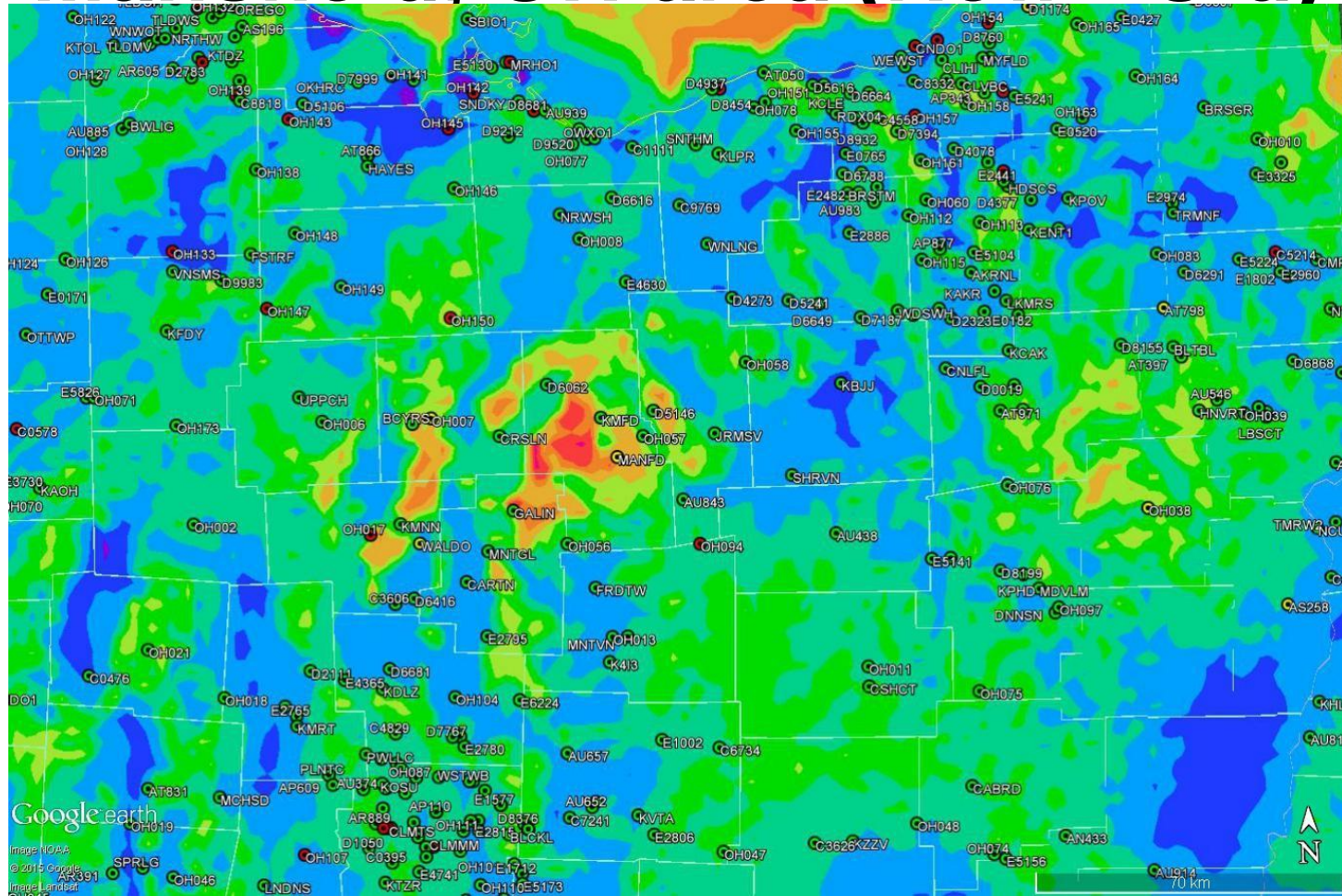
HRRR Snow Cover



NAM Nest Snow Cover (in)



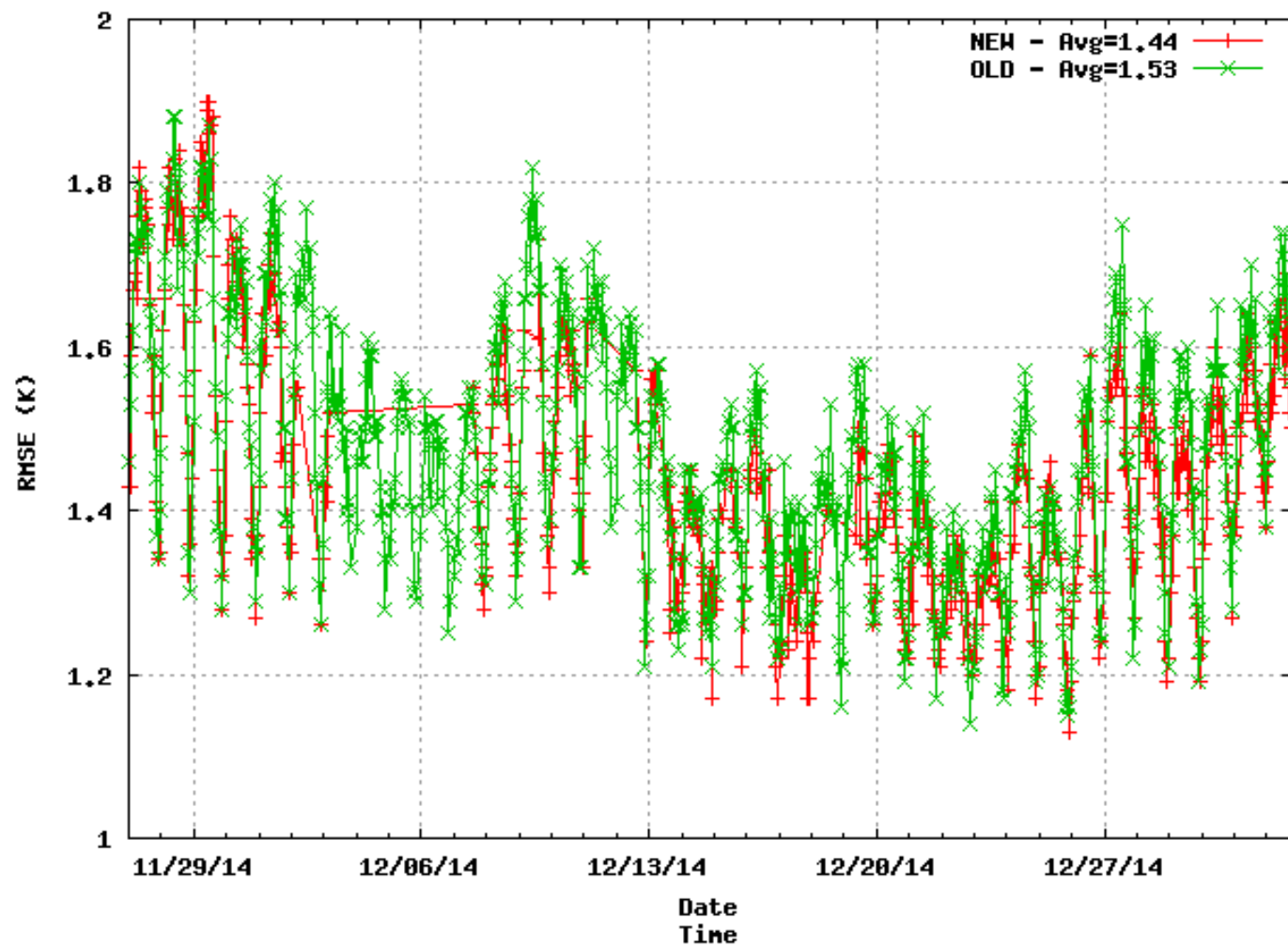
Mansfield, OH area (New - Old)



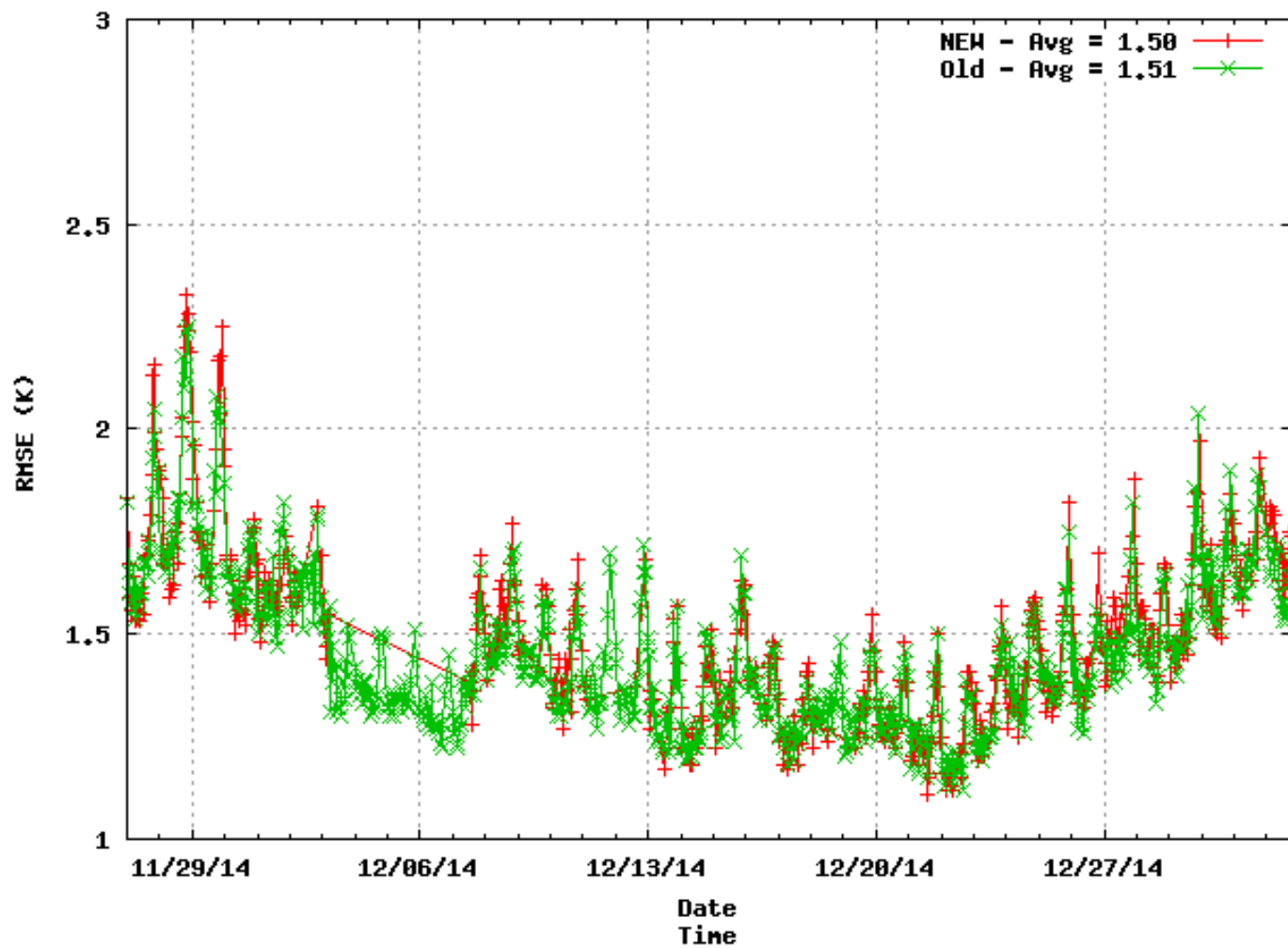
Differences at Obs

Station	Observed	Old BG	Old Anl	New BG	New Anl
KMFD	9	-2.1	-2.7	8	6.4
GAILN	8.2	-10.2	-10.6	7.1	5.3
OH076	9	7.8	13.6	8.9	13.2
OH021	11	0	5.3	8.3	8.7
KMNN	3.8	-0.5	8.2	3.7	3.1
KBJJ	4.9	6.2	11	5.5	5.6

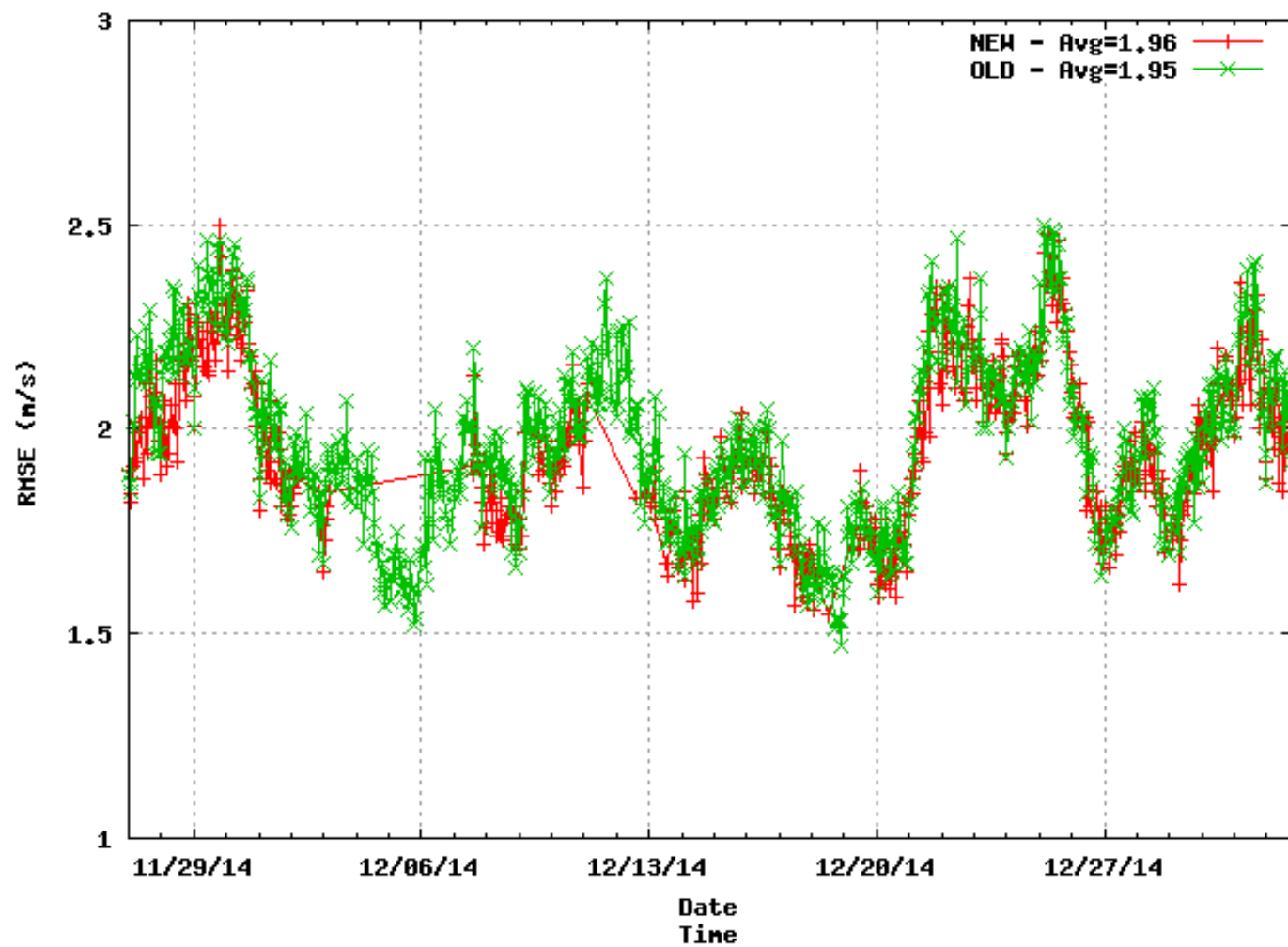
Temperature RMSE Stats



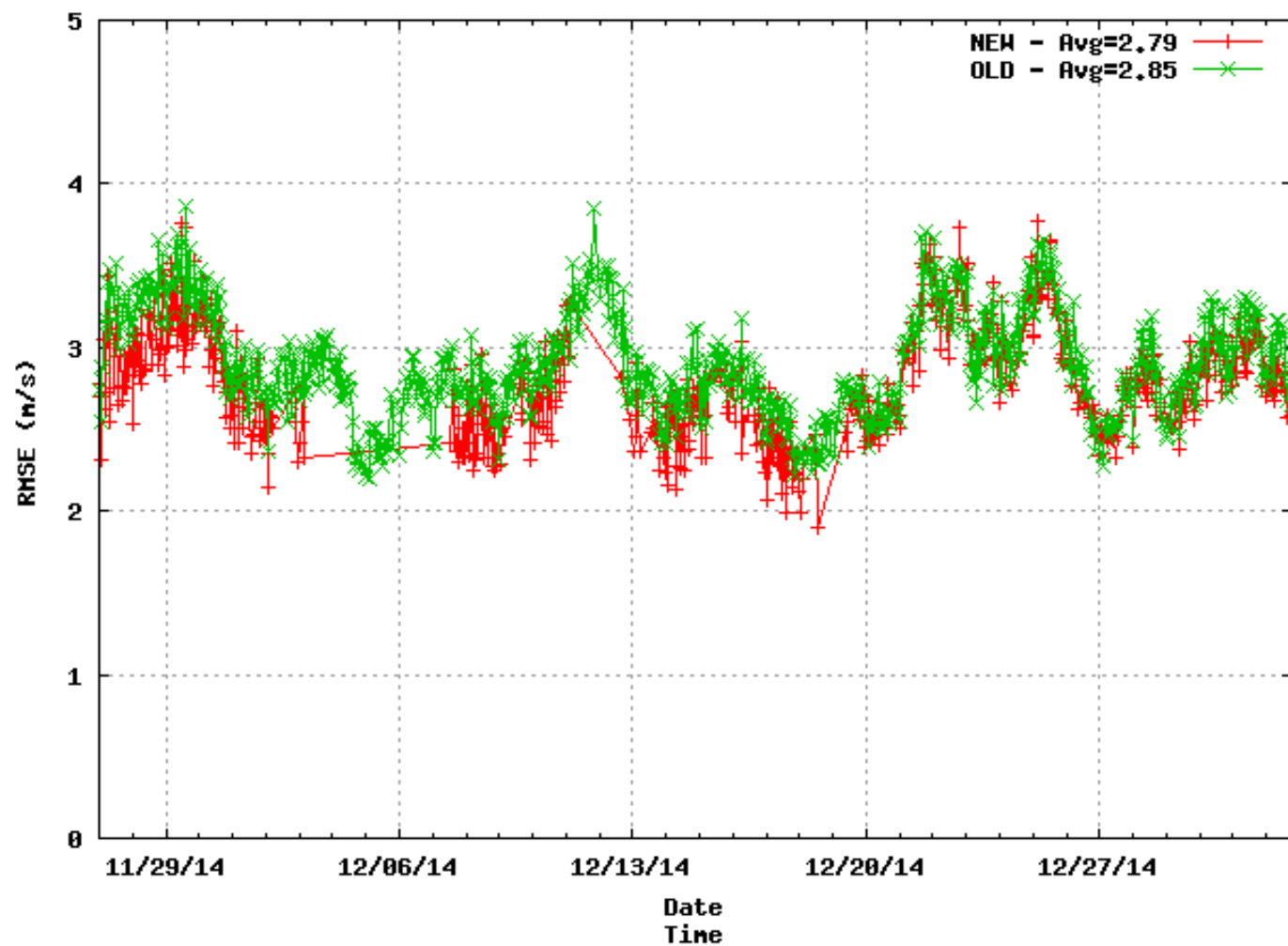
Dew Point RMSE Stats



Wind Speed RMSE Stats



Gust RMSE Stats



Initial Analysis of Product Volume

Disk Usage	Current Production	Expected New Production	Actual New Production
IBM Disk	2160 GB /day	3060 GB /day	-
IBM Tape	155 GB/day (70 Permanent + 85 2-year)	160 GB/day (73 Permanent + 87 2-year)	-
NCEP FTP Server	8 GB/day	11 GB/day	-
NWS FTP Server	7 GB/day	11 GB/day	-

Note: IBM Disk usage estimate assumes 3 days of output residing in /com for CONUS RTMA & URMA, and Alaska RTMA, and 5 days for RTMA Hawaii, Prico, & Guam

Analysis of Production Resources

RTMA CONUS-2.5km

Increase number of processors from 48 to 64. Use 8 nodes. Run time to remain at around 15 minutes

URMA

Increase number of processors from 48 to 64. Use 8 nodes. Run time to increase from 17 to 19-20 minutes.

RTMA Alaska-3km

No changes. Continue to use 32 processors distributed over 4 nodes. Run time to remain at 4 minutes.

Hawaii, Puerto Rico, Guam RTMAs

No changes. Continue to use 7 processors on 1 node. Run time to remain at < 4 minutes.

Dissemination of RTMA & URMA total cloud amount

For CONUS : via NCEP FTP server, NOAAPORT, NOMADS, and NDGD

For NWRFC: via NCEP FTP server and NOMADS

Bandwidth Requirements : Additional 0.5 GB/day

DEPENDENCIES

UPSTREAM: RAP, HRRR, NAM, GFS, prepdata

DOWNSTREAM: NCEP Global Ensemble

Risk: The quality of the new sky cover may be compromised at times, should the GOES Imager *data of opportunity* from Univ. Wisconsin/CIMSS become unavailable. In such cases, the analysis would only use surface observations.



Real Time Mesoscale Analysis and UnRestricted Mesoscale Analysis v2.3.0 Upgrade



Project Status as of 01/29/2015

Project Information and Highlights

Lead: Geoff DiMego, EMC and Chris Magee, NCO

- Scope:**
1. Replace RAP first guess with HRRR+NAMnest blend for RTMA-CONUS and URMA
 2. In GSI-2DVar, use a “buddy check” observation quality control and enhance the gross-error check to account for terrain variability
 3. Analyze Total Cloud Amount (a.k.a. Sky Cover)
 4. Expand Stage IV/precipitation URMA look-back period to 7 days
 5. Synchronize all RTMA/URMA applications to use the same code

Expected Benefits:

- Improved analysis over complex terrain thanks to improved first guess and observation quality control
- Better QC’ed and more complete Stage IV/precipitation URMA mosaic

Resources

For RTMA-CONUS and URMA, increase number of processors from 48 to 64 distributed over 8 nodes.



Milestone (NCEP)	Scheduling	Date	Status
Initial EE setup (NCO Support)		no need	
EMC testing complete/ EMC CCB approval		10/1/2014 -> 10/15/2015 → 12/09/2014	
Code delivered to NCO		10/10/2014 -> 10/24/2014 → 12/12/2014 → 12/19/2014	
Technical Information Notice Issued		10/10/2014 -> 10/24/2014 -> 12/15/2014 → 02/05/2015	
CCB approve parallel data feed		10/17/2014 -> 10/31/2014 -> 12/19/2014 → 02/05/2015	
Parallel testing begun in NCO		10/27/2014 -> 11/10/2014 -> 01/12/2015 → 02/09/2015	
Real-Time Evaluation Ends		11/27/2014 -> 12/11/2014 -> 02/13/2015 → 03/09/2015	
IT testing begins		10/27/2014 -> 11/10/2104 → 01/12/2015	
IT testing ends		11/3/2014 -> 11/17/2014 → 01/19/2015 → 01/26/2015	
Management Briefing		12/1/2014 -> 12/15/2014 -> 02/24/2015 → 03/17/2015	
Implementation		12/2/2014 -> 12/16/2014 -> 02/25/2015 → 03/18/2015	



Issues:

Issues/Risks

Risks:

Mitigation:



Management Attention Required



Potential Management Attention Needed



Finances

Associated Costs: OST (NextGen) funded contractor
Funding Sources: EMC Base: T2O 6 Man-months. NCO Base: 1 man-months for implementation, 1 man-month annually for maintenance

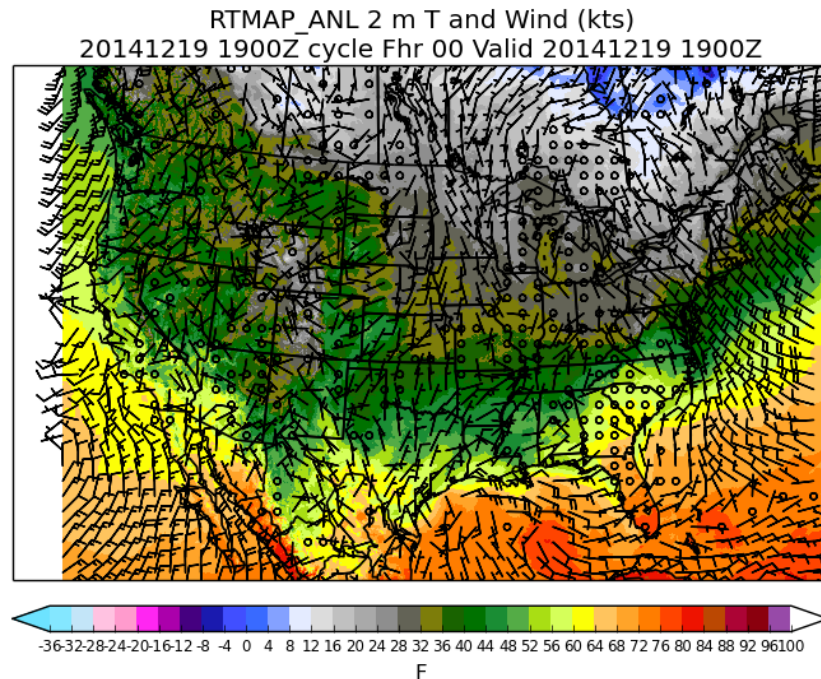
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On Target

Closing

- Some highlights of the Q2 FY15 bundle
 - Sky cover analysis
 - Improved Obs QC (buddy check and terrain adjustment)
 - Higher resolution background
 - Implementation: March 2015
- Some highlights of the Q4 FY15 bundle
 - Nonlinear Quality control
 - Additional analysis variables
 - Significant wave height
 - Ceiling
 - mslp
 - Analysis of maximum and minimum temperature (URMA only)
 - MaxT: 7AM-7PM local time
 - MinT: 7PM-8AM local time

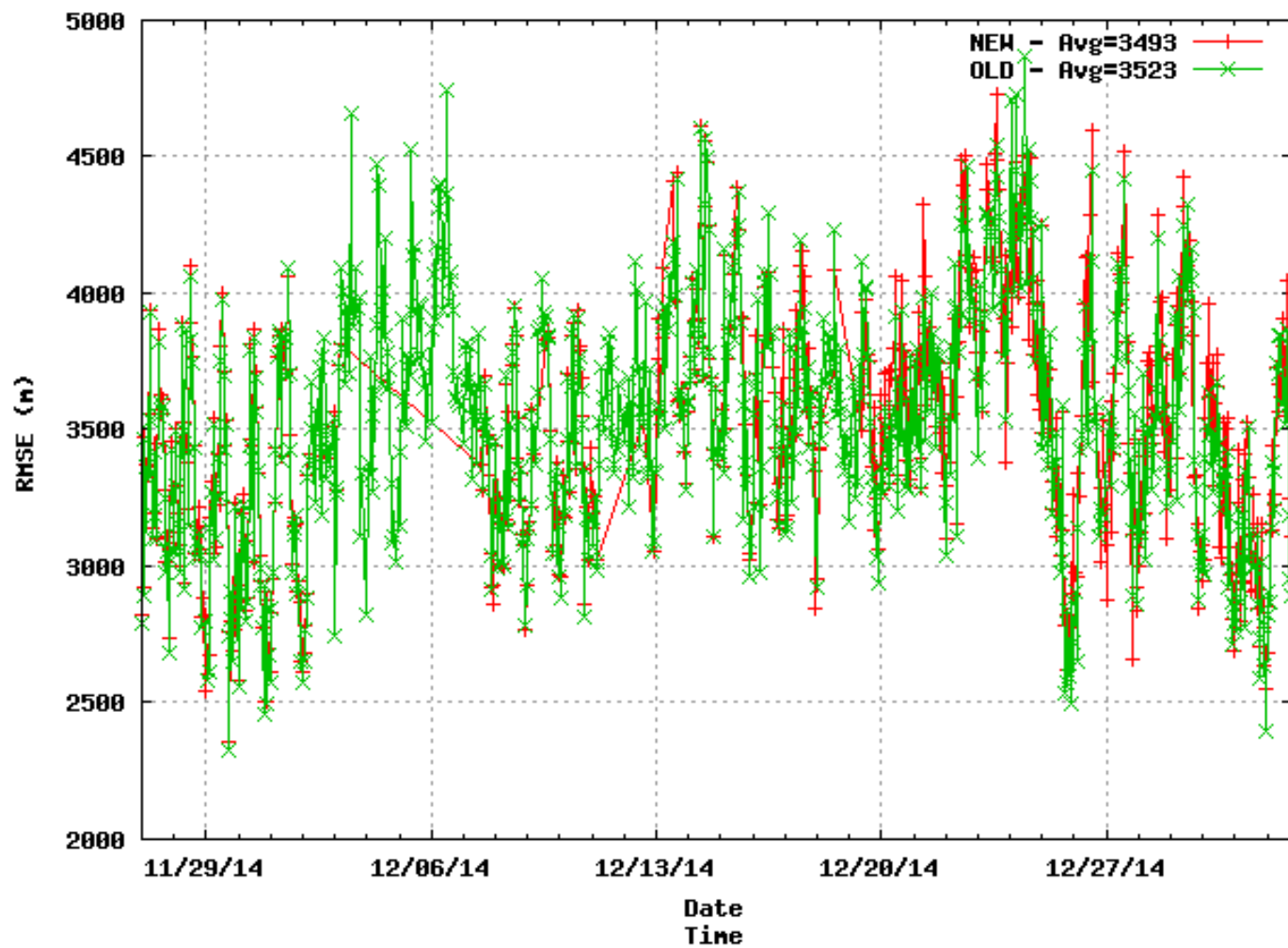


Thanks! Questions?

Thank you to the NWS Regions and WFOs who have provided thorough, continuous feedback on the RTMA/URMA!

BACKUP SLIDES

Visibility RMSE Stats



URMA Walsenburg, CO

All plots valid 2 December 06Z

Colored dots are ob locations by use:

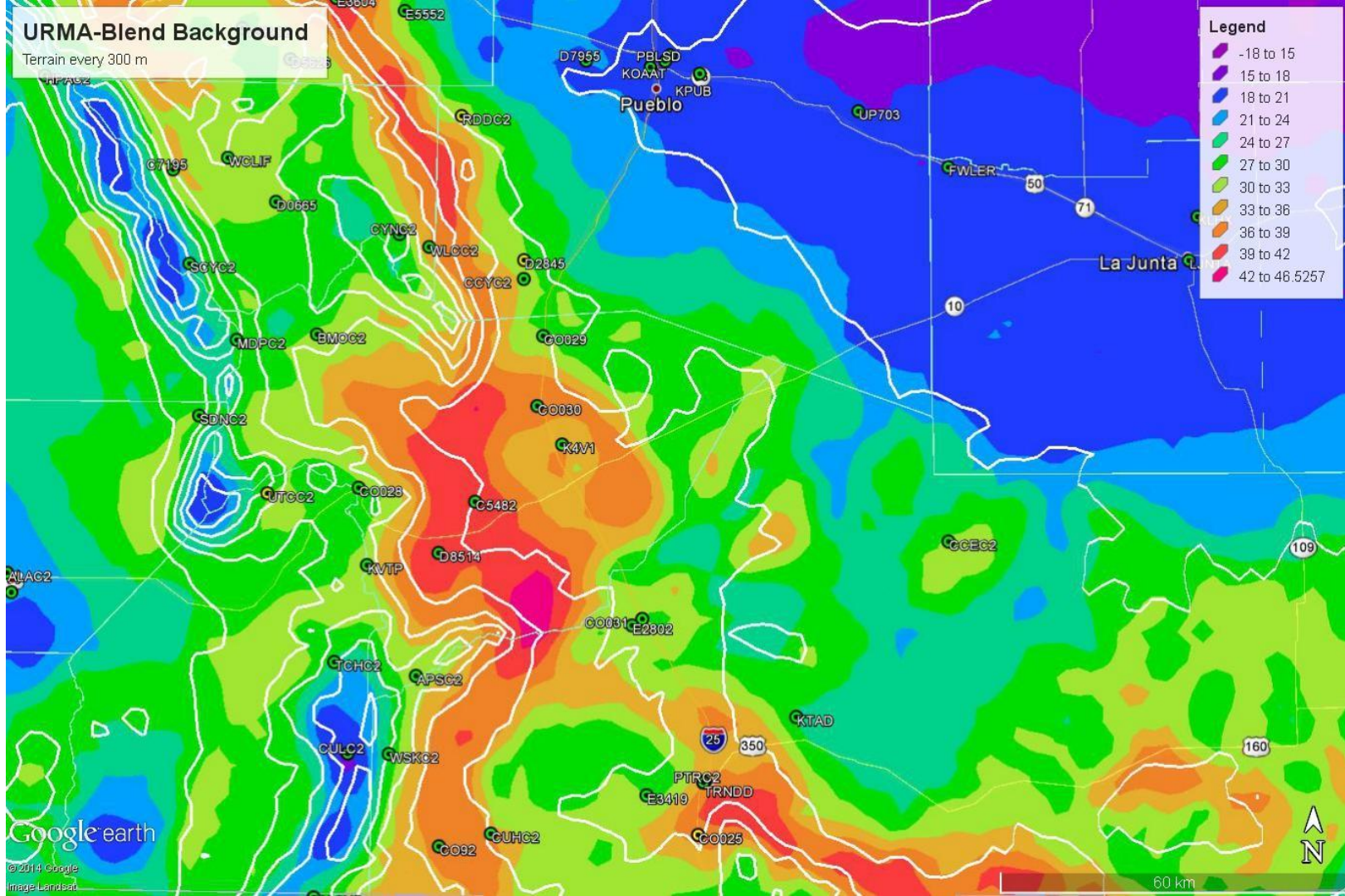
Assimilated

Partially Assimilated

Rejected

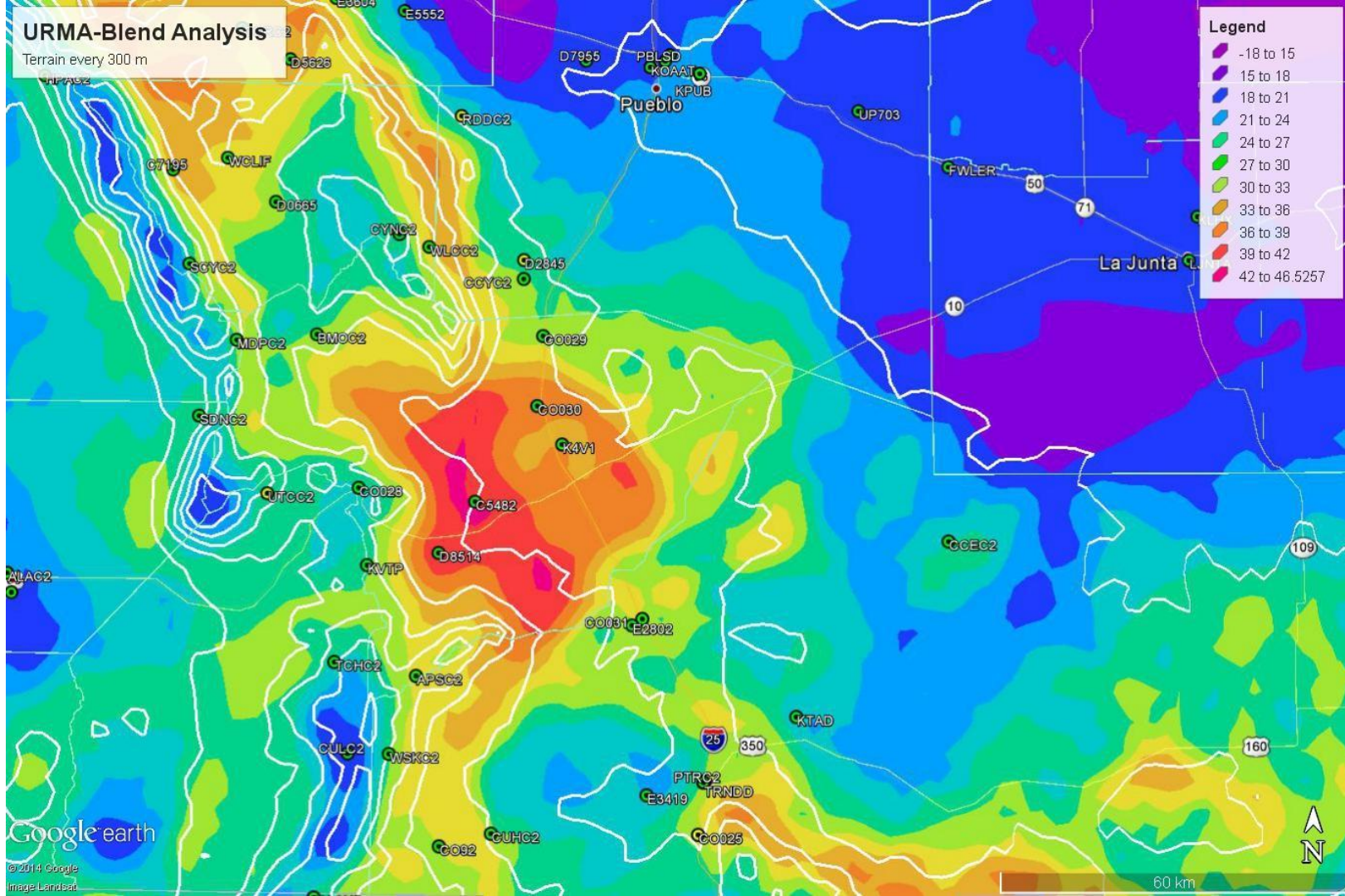
URMA-Blend Background

Terrain every 300 m



URMA-Blend Analysis

Terrain every 300 m



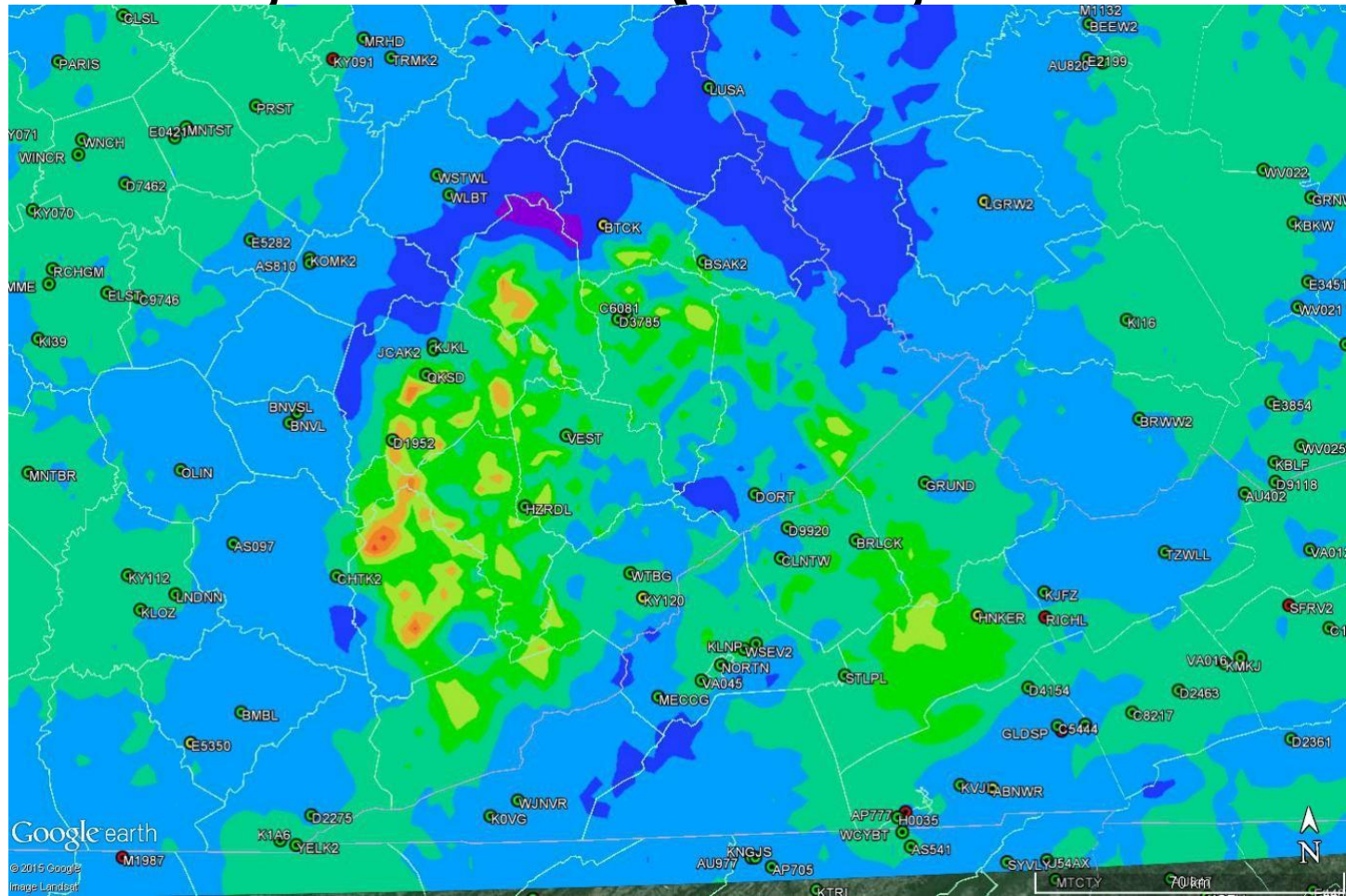
Ob/Background/Analysis Values

Site	Ob	Old BG	Old Anl	New BG	New Anl
K4V1	48.1	35.2	43.3	34.8	38.6
CO030	47.0	35.5	43.8	38.0	41.1
CO029	29.0	37.3	45.6	30.3	31.6
CCYC2	24.9	32.8	38.4	31.9	30.5
D2845	30.8	31.4	36.4	30.5	28.5
CO031	31.9	25.4	28.9	31.9	33.0
E2802	33.2	24.7	27.4	32.6	33.0

Differences at Obs

Station	Observed	Old BG	Old Anl	New BG	New Anl
KIND	17.2	9.8	17.7	16.3	18.1
TRFLG	15.9	2.9	8.3	18.6	18.1
IN035	17.7	22.7	25.4	16.3	19.3
D3126	15.2	7.1	14.3	13.2	15.5
BIGI3	15.9	5.6	10.9	13.9	14.6
E5041	13.9	10.7	18.4	15.2	17.9

Hazard, KY area (E KY, New - Old)



Differences at Obs

Site	Observed	Old BG	Old Anl	New BG	New Anl
KJKL	18.1	13.4	15.9	16.3	15.9
D1952	19.1	4.9	8	18.6	18.6
CHTK2	19.1	17	18.1	20.4	19.3
BTCK	20.0	19.9	23.1	19.0	19.5
KJFZ	17.3	15.5	19.0	14.8	16.4
WLBT	18.2	22.2	20.9	21.1	18.4

Differences at key obs (Lake in ND, 2m T, °F)

Site	Ob	Old BG	Old Anl	New BG	New Anl
KN60	73.1	70.6	69.4	67.9	71.7
ND021	73.5	75.8	74.4	68.9	71.9
ND018	68.1	72.6	70.6	58.7	62.3

